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Machining and Measuring GEAR TEETH

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WITH this article begins the third and last series of thirteen articles on gears under the title given above. The first series of nineteen articles appeared in previous issues under the title "The Design of Gear Tooth Forms" and the second series of twelve articles discussed "Gear Teeth in Action." While these two series were concerned largely with design theory, although thoroughly practical in character, the present series deals with the methods used to attain these results. The measurement of gear teeth is first discussed, and the methods and instruments used to check the tooth thickness, spacing, form of profile, alignment, and the concentricity of the teeth are described in turn. The production of gears by hobbing is next in order, and considerable space in this section is devoted to the design and manufacture of the hobs themselves. Then follows an exposition of the generation of gear teeth by shaping with both pinion- and rack-shaped cutters. The last two articles are devoted to grinding by formed wheels and by generating methods, as well as lapping and burnishing.

Measuring Gear Teeth

THE problem of gear production is essentially the same as all other production problems. The requirements of the finished product should be determined first, and then suitable methods must be selected or developed to produce the required results. Often the exact requirements of the part or the product in question are not fully established until actual production has been under way for some time. This situation imposes on production the additional burden of unanticipated refinements in the manufacturing operations. Such, in brief, has been the history of the production of almost every commodity.

The history of gear production has been no exception to this, but rather an aggravated example. In the first place, the essential requirements of gear teeth have not yet been definitely established. Secondly, the demands made on the performance of gears are constantly growing more severe. While in the third place, although many different methods for producing gears are now available, not one of them has yet proved itself to excel in all features; each method has its own advantages and all have certain disadvantages. The first essential to satisfactory production is knowledge of the essential requirements or elements. If the essential element of a composite surface, such as a gear tooth profile, is singled out for primary attention, a very high order of accuracy can be obtained. The fewer elements we try to maintain to any specified degree of accuracy at one time, the higher the degree of accuracy it is possible to maintain.

> Inspection methods that will prevent faulty parts from being produced are of far more value than those that merely sort the good parts from the bad. Hence the measurement of the tools and the machines that are used to produce the gears should receive primary attention, not the product

The next essential is suitable means of measuring. We must be able to detect and measure definitely any troublesome errors before we are in a position to correct them. Here again we are at a disadvantage in the production of gears. Many valuable and ingenious testing instruments have been devised, but almost without exception they are more of the type of laboratory instruments than every-day shop testing tools. Such laboratory instruments have an important place to fill, but production requires testing facilities that are simple, rapid, and effective. However, until we know definitely the characteristics of the gear teeth that require continual watching, we are at a disadvantage when we attempt to evolve facilities to test them. This

is the principal reason why such testing means have not yet made their appearance. Despite the lack of this essential—suitable means of measuring—production must be maintained. In fact, all production is carried on despite more or less inadequate information and equipment. In general, measurement or inspection should be employed more as a preventative than as a cure. Inspection methods that will prevent faulty parts from being produced are of far more value than those that merely sort the good parts from the bad. The ideal inspection and production system would be to have tools and equipment of such reliability that periodic tests of this equipment alone would insure correct results. This is the end towards which we should always strive. The more nearly any production process approaches this condition, the less the attention that is required to measure the product. The measurement of the tools and the machines used to produce the gears should always receive primary attention. Proper inspection here will save the production of faulty parts. The inspection of this equipment should be much more complete and elaborate than the measurement of the gears themselves. Too often, however, inspection is considered only as a process of sorting the product. Some sorting is always necessary, but this is a minor and not a major duty of inspection.

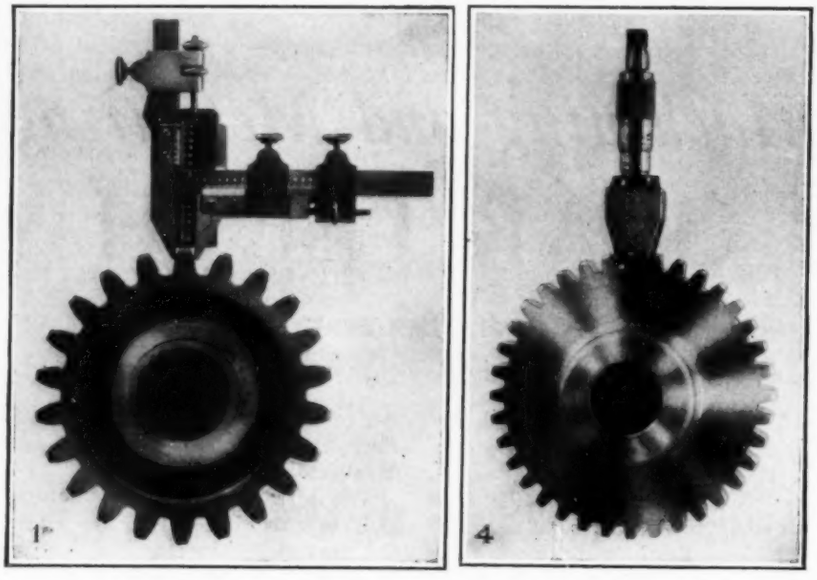


Fig. 1—Gear tooth vernier. The horizontal scale measures the chordal thickness, the vertical one, the distance of this chord from the outside diameter. Fig. 4—Gear tooth micrometer measuring the contact depth of the rack-shaped opening. The width of tooth is then calculated

Fundamentally the measurement of gears is the same as the measurement of any other mechanical part. With gear tooth profiles, as with all other types of surfaces, we are confronted with the fact that the accuracy to which we can work depends upon the accuracy to which we can measure. As stated before, we must be able to measure errors before we can correct them.

Before we can measure and make intelligent use of such measurements, however, three questions must be answered: First, what shall we measure? Second, why should we measure it? And third, how shall we measure it?

For most machined surfaces, these questions have relatively simple answers. Gear tooth profiles, however, have so many interdependent elements that satisfactory answers have not as yet been found for all of them. The further discussion will single out the more important elements of gear tooth profiles and show typical methods that are now employed to measure them.

The distinction between the testing of the manufacturing equipment and the product itself should always be kept in mind. That is, measurements made to test the accuracy of the production equipment can be as elaborate as necessary with but little effect on the final cost of the product because such tests are required periodically only. Therefore if simple methods are not available, the more elaborate ones should be used. On the other hand, measurements that are made to test the product itself must be simple and direct to be economical. Therefore, when considering the measurement of gears and the various types of measuring equipment available, these two distinct purposes should not be confused. We will now consider the more essential characteristics of gear tooth profiles. Spur gear teeth of full-involute form only will be considered. The more essential elements of such gears may be listed as follows: thickness of teeth; concentricity of teeth; alignment of teeth; spacing of teeth; and form of tooth profiles.

Why should the thickness of gear teeth be measured?

If the teeth are too thick, the gears cannot be assembled at the desired center distance. If the teeth are too thin, excessive backlash will be present. In extreme cases, the teeth would be weakened.

The actual amount of backlash required depends upon several factors. The more accurately the center distance is maintained, the smaller the amount of backlash required. As a matter of fact, the tolerance on the center distance for spur gears should always be plus, as a variation in that direction introduces only a little more backlash while a variation in the opposite direction reduces the backlash and introduces the possibility of jamming the teeth. The amount of backlash required depends also upon the pitch-line speed of the gears. High-speed gears require more backlash than slower ones in order to prevent jamming when the gears are heated in operation. On the other hand, for gears running at moderate speeds, the smaller the backlash, the less chance is there of rattling when the gears are running idle. This factor is of particular importance on the constant-mesh gears of automobile transmissions.

After the minimum backlash is established, the maximum is controlled largely by the process of manufacturing. The tolerance on the tooth thickness would vary from about one thousandth of an inch on ground gears to about five thousandths of an inch on cut gears of 5 diametral pitch and finer. On coarser pitches, this variation will be somewhat larger.

In general, the measurement of the tooth thickness of gears is the simplest method of control in production. If the other elements of the gear teeth can be satisfactorily maintained by periodic tests of the equipment and by proper care in the set-up of the blanks, the measurement of tooth thickness alone on the product would be sufficient.

How Can the Thickness of Gear Teeth Be Measured?

Several methods are available for measuring the thickness of gear teeth. Some of these methods measure the thickness directly while others measure it indirectly and also give an indication of the errors in some other elements at the same time.

First we have the gear tooth vernier which is shown in Fig. 1. This instrument has two vernier scales, one to measure the chordal thickness of the gear teeth and the second to measure the distance from this chord to the outside diameter of the gear. If this outside diameter varies, a corresponding correction must be made in the setting of the second vernier scale.

Calculating the Tooth Thickness

Usually the arc thickness of the tooth is known. In order to measure with this instrument, it is necessary to calculate the chordal thickness and also the distance of this chord from the outside diameter of the gear. Referring to Fig. 2, when

T = arc thickness of gear tooth at radius R, in.
R = radius at which arc thickness of tooth is known, in.
E = outside radius of gear, in.
C = chordal thickness of gear teeth, in.
A = distance from outside of gear to chord (known as "corrected addendum"), in.
β = angular thickness of gear tooth.

$$\text{arc } \beta = \frac{T}{R}$$

$$C = 2R \sin \frac{\beta}{2}$$

$$A = E - R \cos \frac{\beta}{2}$$

As a definite example, we will determine the value of the chordal thickness and corrected addendum on the following gear tooth:

$$T = 0.260 \text{ in.}$$
$$R = 1.000 \text{ in.}$$
$$E = 1.1667 \text{ in.}$$
$$\text{arc } \beta = \frac{T}{R} = \frac{0.260}{1.000} = 0.260 \text{ radians}$$
$$\beta = 14^\circ\ 54'$$
$$C = 2R \sin \frac{\beta}{2} = 2 \sin 7^\circ\ 27' = 0.2593 \text{ in.}$$
$$A = E - R \cos \frac{\beta}{2} = 1.1667 - \cos 7^\circ\ 27' = 0.1751 \text{ in.}$$

The actual contact between this gear tooth vernier and the gear tooth is at the corner of the jaws. Hence, if this corner becomes worn, the instrument will give a false reading. If accurate measurements are to be obtained, these instruments should be calibrated from time to time and the necessary correction made to the reading of the instrument.

A simple method of calibrating these gear tooth verniers is shown in Fig. 3. The theoretical addendum and chordal thickness settings may be readily calculated for any diameter of cylindrical plug gage that may be available. It is a good plan to calibrate these instruments for the same angle as the pressure angle of the gears to be measured. Thus when

D = diameter of plug gage, in.
A = addendum setting or height of segment, in.
C = thickness setting or length of chord, in.
α = pressure angle of gears to be measured, deg.

$$A = \frac{D}{2}\ (1 - \sin \alpha)$$

$$C = D \cos \alpha$$

To calibrate the instrument, the height vernier is set to the calculated addendum setting A, and the length of the chord C is measured with the other vernier. The difference between this measurement and the calculated length of the chord C is the correction to be used when measuring the thickness of gear teeth.

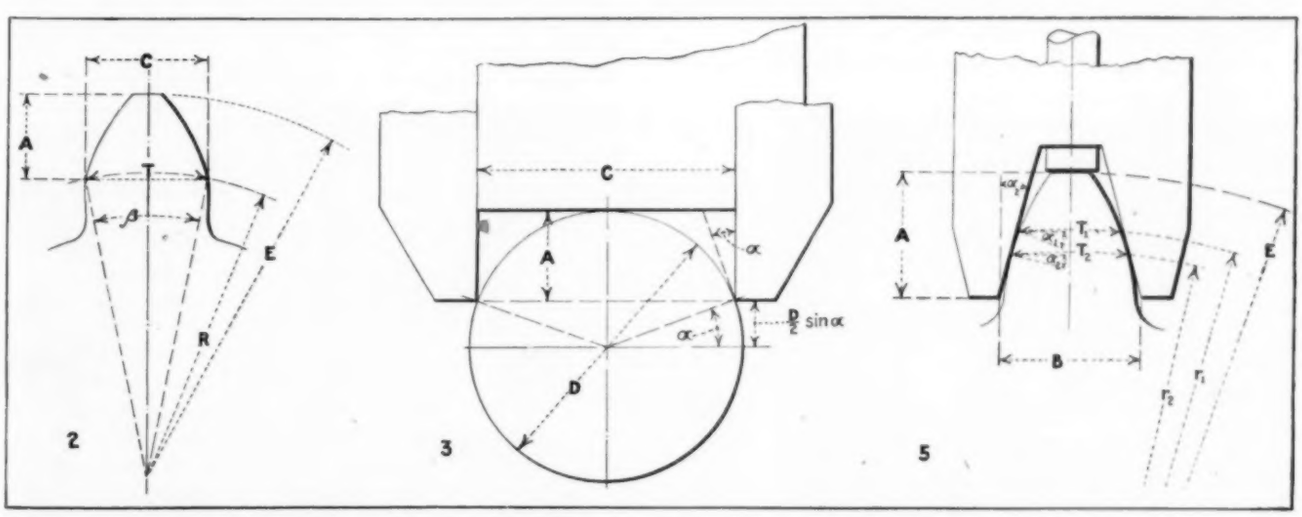


Fig. 2—Application of the gear tooth vernier. Fig. 3—Calibration of a gear tooth vernier. Fig. 5—Use of the gear tooth micrometer

As a definite example, we will calculate the settings for calibration purposes on a 1-in. plug gage for a pressure angle of 20 deg. This gives us the following:

$$D = 1.000 \text{ in.}$$

$$\alpha = 20°$$

$$A = \frac{D}{2}(1 - \sin\alpha) = \frac{1}{2}(0.65798) = 0.3290 \text{ in.}$$

$$C = D\cos\alpha = 0.9397 \text{ in.}$$

If the actual measurement of the chord should be 0.9380 in., we must add the correction of 0.0017 in. to the reading of the vernier when measuring a gear tooth to obtain the correct measurement.

These instruments cover a wide range of pitches and pressure angles, thus making them particularly valuable for use on general jobbing work. The smallest one covers a range from 20 diametral pitch to 2 diametral pitch, while a larger instrument covers the range of from 10 to 1 diametral pitch.

Another instrument which is used to measure the tooth thickness of gears is the gear tooth micrometer which is shown in Fig. 4. The base of this instrument represents a space of the basic rack and fits over the tooth of the gear to be measured, while the micrometer is adjusted to touch the outside diameter of the gear. A variation in the height thus measured indicates a variation in the thickness of the tooth. If the outside diameter of the gear varies, a corresponding correction must be made in the reading of this instrument.

This instrument makes contact with the gear tooth profile on a plane surface. A separate instrument is required for each different pitch. The same instrument may be used on gears of different pressure angles, but this involves considerable calculation so that it is usually advisable to have a separate instrument for each pitch and pressure angle. These instruments are primarily intended for extensive production gaging.

When one of these gear tooth micrometers of one pressure angle is used to measure a gear tooth of different pressure angle, the following calculation must be made: Referring to Fig. 5, when

A = gage or micrometer setting, in.
T_1 = arc thickness of gear tooth at r_1, in.
r_1 = pitch radius of gear with pressure angle of α_1, in.
α_1 = pressure angle of *gear*, deg.
T_2 = arc thickness of tooth at r_2, in.
r_2 = pitch radius of gear for pressure angle of α_2, in.
α_2 = pressure angle of *gage*, deg.
B = width at bottom of space in gage, in.
E = outside radius of gear, in.

We have from problem 6* on page 556, Vol. 64, of the *American Machinist*,

$$r_2 = \frac{r_1\cos\alpha_1}{\cos\alpha_2} \qquad \text{Equation (39)}$$

$$T_2 = 2r_2\left(\frac{T_1}{2r_1} + \text{inv}\,\alpha_1 - \text{inv}\,\alpha_2\right) \qquad \text{Equation (40)}$$

From Fig. 5 we have,

$$A = E - r_2 + \frac{B - T_2}{2}\cot\alpha_2$$

As a definite example we will take a 20-deg., 6-D.P. gear with 24 teeth, tooth thickness 0.260 in., and calculate the gage setting for a 14½-deg., 6-D.P. gear tooth micrometer. These instruments are usually made so that the gage setting represents the working depth of the tooth on a gear tooth of basic size and pressure angle.

Whence $B = \frac{CP}{2} + \frac{2}{6}\tan 14\tfrac{1}{2}° = 0.3480$ in.

$$T_1 = 0.2600 \text{ in.}$$
$$r_1 = 2.0000 \text{ in.}$$
$$\alpha_1 = 20°$$
$$\alpha_2 = 14\tfrac{1}{2}°$$
$$B = 0.3480 \text{ in.}$$
$$E = 2.1667 \text{ in.}$$

$$r_2 = \frac{r_1\cos\alpha_1}{\cos\alpha_2} = \frac{2 \times 0.93969}{0.96815} = 1.9412 \text{ in.}$$

$$T_2 = 2r_2\left(\frac{T_1}{2r_1} + \text{inv}\,\alpha_1 - \text{inv}\,\alpha_2\right)$$

$$= 3.8824\left(\frac{0.2600}{4.0000} + 0.01490 - 0.00554\right) = 0.2887 \text{ in.}$$

$$A = E - r_2 + \frac{B - T_2}{2}\cot\alpha_2$$

$$= 2.1667 - 1.9412 + \frac{0.3480 - 0.2887}{2}\cot 20°$$

$$= 0.3070 \text{ in.}$$

*"The Design of Gear Tooth Forms" by Earle Buckingham.

Surroundings Are Important for Best Vision

IF WE look at lighting in relation to effective and efficient vision we find it much more than a matter of so many footcandles delivered to a hypothetical workplane. An interesting phase of efficient vision is in the brightness of the immediate field surrounding the object to be seen. For example, a careful investigation of accuracy of vision for illumination intensities from 5 footcandles to 100 footcandles revealed some interesting facts as to the importance of the brightness of the surroundings. The small objects to be seen were ordinary black lines such as letters on a small white background. When the surrounding field was much darker than the small white background the accuracy was no greater at a 100-footcandle illumination of the object than when the surrounding field and the object were both equally bright and illuminated to an intensity of only 5 footcandles.

Of course, other factors such as the brightness of the surrounding field being the same, vision was more accurate, easier, and quicker at 100 footcandles than at 5 footcandles. However, a dark background in the former case sacrificed all the advantage gained. This investigation argues for general lighting and when additional localized lighting is used it argues that the spot of high intensity should not be too small.

In general the field surrounding the object should be about as bright as the average brightness of the object and its immediate background. However, what the extent of this surrounding field should be is not known exactly at present. Other factors lead one to believe that it should extend about 25 deg. from the line of vision in all directions. Sometimes special backgrounds should be used to provide this surrounding field.

There are other conditions which demand a general illumination of at least several footcandles even though it is augmented by localized lighting and backgrounds.

Methods and Fixtures for Air-Compressor Work

By Fred H. Colvin
Editor, American Machinist

THE Laidlaw plant of the Worthington Pump and Machinery Corporation, Cincinnati, Ohio, contains some special machinery that has been built to handle work rapidly and accurately, without the necessity of resetting for different operations. One of these is a Beaman & Smith combined milling and boring machine, an air compressor bed being shown in place in Fig. 1. Three milling heads are shown, surfacing one side of the bed and milling the seats for the crankshaft bearings. The bed is supported on the cross parallels *A* and *B*. At the same setting the boring bar *C* bores the opening at the end and faces the flange to which the cylinder is bolted, thus insuring that the cylinder and crankshaft will be square with each other.

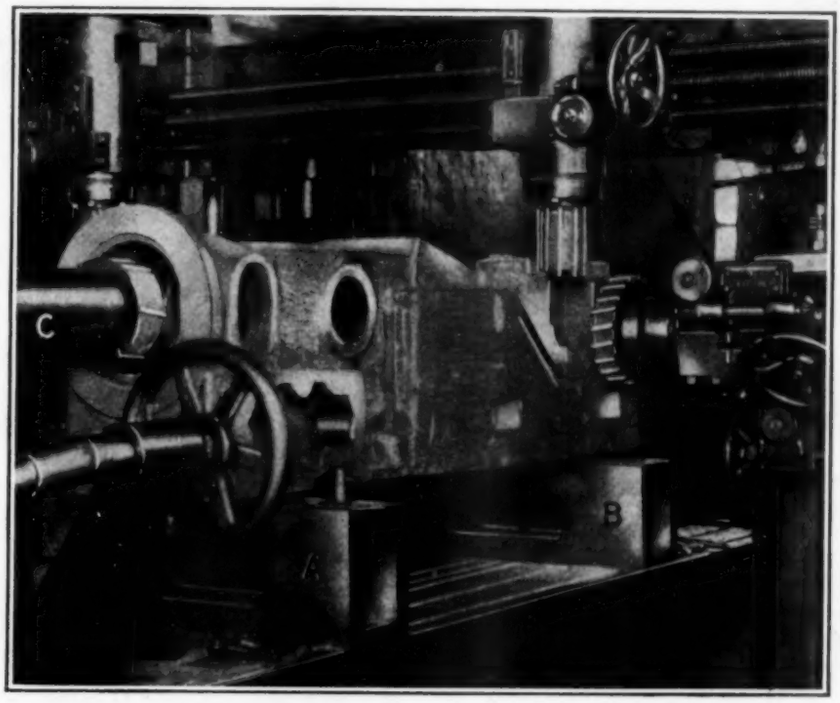
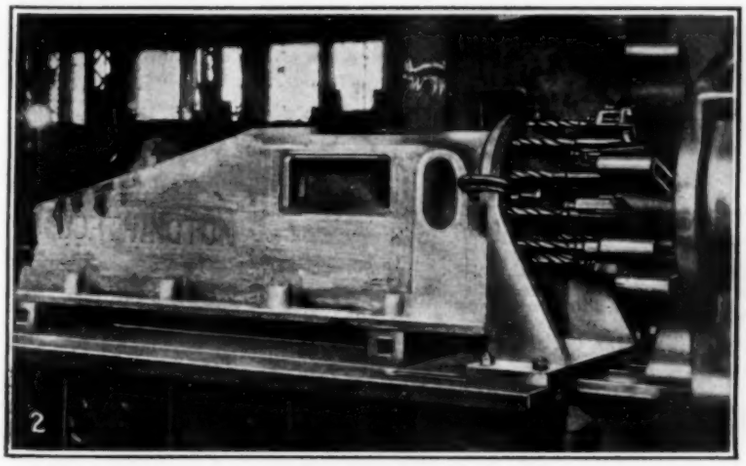


Fig. 1—Boring and milling at one setting

The drilling of the flange holes is done in the horizontal multi-spindle machine in Fig. 2. The angle plate to which the frame is bolted also serves as a bushing plate for locating the various holes. The method of machining another type of compressor bed is shown in Figs. 3, 4 and 5. The bed is mounted on the substantial cast-iron block *A*, Fig. 3, while the cross opening is bored on the Barrett machine shown. The sides are also faced by means of a tool in the facing arm, fed by the conventional star feed. The base plate and bed are then swung at a right angle, Fig. 4, and the crosshead guides are bored and the cylinder flange faced square



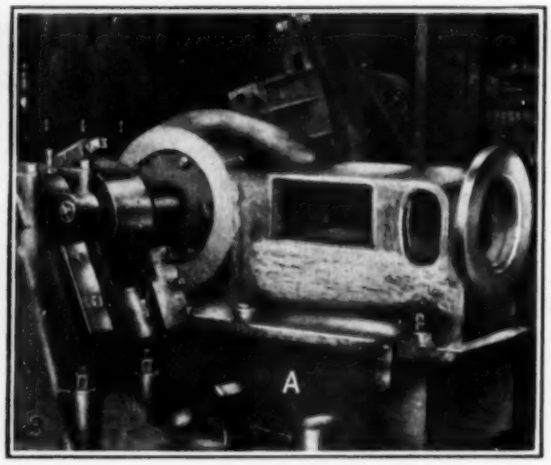
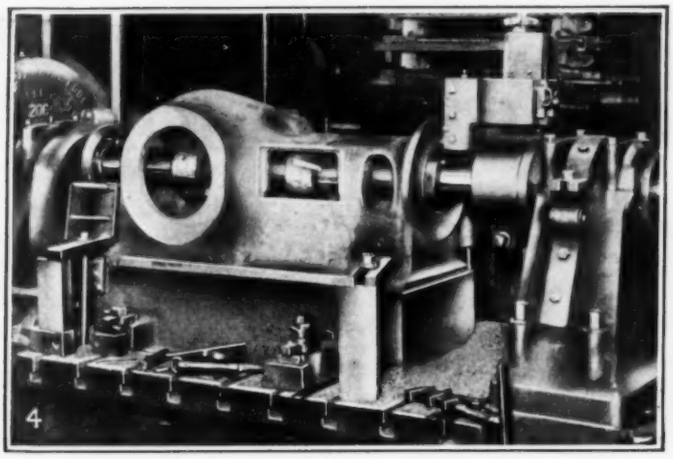


Fig. 2—Drilling the cylinder flange. Fig. 3—Cross-boring another type of bed



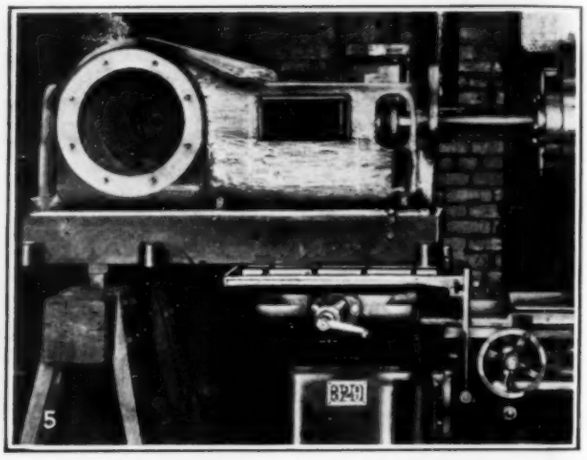
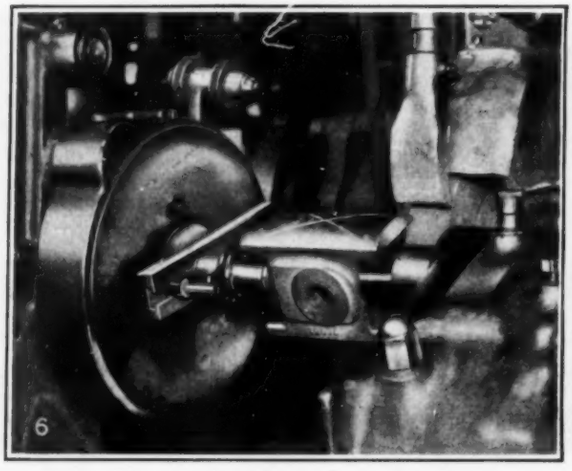


Fig. 4—Boring crosshead guides. Fig. 5—Grinding guides, using same fixture



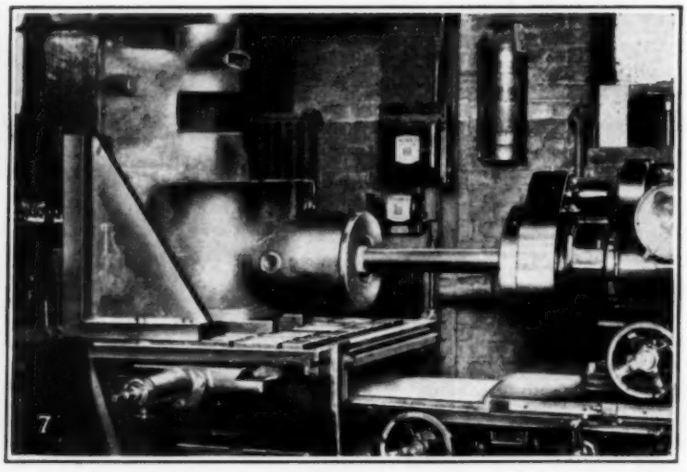


Fig. 6—Finishing crosshead in grinder. Fig. 7—Grinding another type of cylinder

with them. The same machine is used for both operations.

The crosshead guides are then ground on a large, planetary or cylinder grinder, Fig. 5, made by Churchill and imported for work larger than could be handled on the regular cylinder grinders. It is also used for grinding large cylinders. In the boring operation 0.017 in. has been left for grinding.

The crossheads are ground to size as shown in Fig. 6, using a mandrel to hold and swing them in the large grinder shown. Both the guides and the crosshead are held to sizes that permit assembling without selection.

Some idea of the variety of work for which the large cylinder grinder is used can be had from Fig. 7. Here another type of cylinder is being ground, the whole base or frame casting being mounted on the table.

Storehouse Contacts for the Draftsman

By John F. Hardecker

"I HAPPENED to be passing through the machine shop today when I overheard the foreman cussing out the drafting room for calling for trick steels that couldn't be obtained," said Bill Smith to his fellow chief draftsman.

"Naturally I was mad, because I had taken pains to get out an advance list of raw material. After a little looking around I found some alloy steel left over from an old job that could be used. That saved the job, but if I hadn't happened along, it would be still held up. I'd like to know how to avoid things like this."

"Well," said Jack, "I was talking to Ed Jones of the Eagle Aircraft Company the other day, and he told me something that they were doing that sounds like the answer. Ed evidently had run into something of the same difficulty, for he has a man who is a sort of storehouse contact man. It's part of his duties to make visits to the storehouse and just sort of snoop around, keeping himself familiar with everything that's there, particularly raw materials. Then when any job that requires special material comes along, the men have instructions to take up the material requirements with him before specifying them on the drawing. He tells me it's surprising how many times they are able to use up from stock some special stuff that otherwise would be sold as excess material or junk. It makes sure that the special material is there for the special job, too, and I believe you could do the same, Bill."

Machine Tool Progress in the Twentieth Century

By JAMES E. GLEASON
President, National Machine Tool Builders' Association

Extracts from the president's address to the twenty-fifth spring meeting of the National Machine Tool Builders' Association

DURING the twenty-five years of its life we have seen our association grow approximately sevenfold in membership and influence. Of the original charter members who composed that first meeting in June, 1902, at the Waldorf-Astoria, only two withdrew, and eleven are still active, individually or in subsequent combinations. Many problems have been met and overcome. Even the shocks of a world war passed over us without disturbing our solidarity. The spirit of co-operation and the many personal friendships built up among our members have sustained us in times of slack business and helped us to take advantage of more prosperous periods. We have worked continually toward a better understanding of those principles of good business upon which we must build if we are to maintain our business structures over a term of years.* As a result of the work of our committees we adopted a uniform cost system in 1923 which has possibilities of service that are as yet very far from being realized. We all know that it is not a cure for high costs, but our committees have assured us that it will help prevent us from being deceived by inadequate figures and guard us from innocently injuring our own business, and that of others at the same time, through the use of selling prices based on estimates that represent only a portion of our costs.

> Whatever may have been true during and immediately after the war, there can now be no question that never in our history has labor been so efficient as it is today, and we have the responsibility of retaining this efficiency by keeping our forces intact. We must contrive in some way to avoid such drastic reductions in personnel as we have suffered in the past

We have simply set up an example that will cover all the elements of costs entering into the processes in the plants of our members, both large and small. Manifestly, it is not necessary that any system be molded into the exact form recommended so long as all the essentials are treated in the same manner.

There is still work for our cost committee to do in gathering data, particularly in regard to the so-called "cost of idleness" which is so large a factor in determining our normal costs. If we can determine closely our normal costs we should be able to plan our policies for several years to come and be reasonably sure that at the end of the period our selling prices will, on an average, have resulted in a fair profit. Sales policy is always a delicate subject but one to which for that very reason we should give more earnest consideration. Trade conditions are changing rapidly in our industry and we have a peculiar obligation to found our sales policy on sound, economic principles. But who is to tell us what theories are sound and what are fallacious? Even among the best informed of our members there may be some difference of opinion. Many questions will at once arise in your minds about which our knowledge is still hazy, our ideas unreconciled, and our opinions unformed. Only a short time ago, as we all know, the prosperity of many firms in the automobile industry was threatened by the unwise granting of long terms with too small a down payment. Fortunately the counsel of wise heads prevailed and the fact was recognized that competition, based on uneconomic practices, could only end in ruin.

Recently I received a list of questions on a subject to be presented at the International Convention of Cost Accountants at Chicago next month. Many of you undoubtedly have been asked to answer these same questions. And if any of you are surprised that this subject should arise before an association of cost accountants, the best reason I can assign is that these questions are too pressing to be thrust aside. If they are not considered by executives, they are bound to demand attention elsewhere. With your permission I will quote two of them:

*This address was delivered at West Point, N. Y., May 10, 1927.

"Do you believe that business should ever be taken below normal cost?

"Do you consider it fair to other concerns in the same industry to take business at or below normal cost?"

Vital questions these and ones which we, as executives, must decide for our respective companies. We cannot delegate this duty to anyone. On the right solution depends the welfare of our business.

The decisions must be made by us as individuals, but unless they rest on theories that are economically sound they will have an unfortunate effect upon the prosperity of our industry as a whole.

Very early in our organization work we established a permanent committee on standardization. This committee, as early as 1910, had sufficient influence to obtain the co-operation of the Electric Motor Manufacturers' Association in working out a range of horsepowers suitable for motor drives on machine tools.

As the years have passed the committee has struggled hard to establish standards of construction for machine tools that would be of real advantage to our industry. Being practical men they were not satisfied to set up "paper" standards. By that I mean standards which for one reason or another would not be put into practice. They have consistently labored to devise standards built on mutual concessions and adjustments that would not only be put immediately into practice but would also be recognized by the user as the last word in improved design. At last these efforts are bearing fruit. Very recently, as you know, an agreement was reached regarding structural standards for milling machine spindles. As we consider this result of work advocated so strenuously by William Lodge, way back at the beginning of our association, we can imagine how much satisfaction it would have given him to read the advertisements which have appeared in our trade papers within the last few weeks proclaiming this adoption of standards by a milling machine group belonging to our association. If proof were needed we see it here, that the machine tool builders *have* ideals and *will* work in harmony to the mutual advancement of their product and the advantage of their customers. And I am sure that we will soon hear announcements of the adoption of like standards from groups of our members building other machine tools.

Must New Markets Be Found?

During last year a great many machine tools were installed in the various automobile shops. Their plants were expanding rapidly to take care of increased schedules. Most of our members were able to increase their efficiency by steadier production with increased forces. Each of the last three years has given us collectively more business. Now conditions have changed materially. Expansion in the metal working field has slackened. So far as capacity only is concerned the automobile shops can continue to meet the demand for cars for some time to come. We are apparently approaching one of those periods when the machine tool builder is expected to act the part of a bystander, for we have seen in the past many times that, once we have equipped the shops of our customers, we have to step aside until we can devise new, high-production machines, enough better than those in use to induce further purchases on the part of our customers. Whether or not such a time is immediately in prospect it is well that we should be prepared to face it, and this is true not only for the preservation of our business but because we have a duty to perform toward our men.

Whatever may have been true during and immediately after the war, there can now be no question that never in our history has labor been as efficient as it is today, and we have the responsibility of retaining this efficiency by keeping our forces intact. We must contrive in some way to avoid such drastic reductions in personnel as we have suffered in the past.

There used to be a good deal of talk about the rights of capital as opposed to the rights of labor. Now we hear more of the mutual responsibility of capital and labor; the responsibility of capital to provide good working conditions and fair rewards; the responsibility of labor to perform its daily tasks loyally and efficiently. But there is another responsibility which it seems to me is fully as important, the responsibility of management and what many of us call the "organization" to counteract the tendency of business to run to high peaks and deep valleys, and to insure continuity of employment for the men in our plants.

Orders Vital to Operation

Of course, to keep our plants occupied we must have orders, but as I see it at this time the placing of orders depends more on us than it does on our customers. Competition is growing keener every day in all the large industries. The loudest complaint is that profit per unit is too small.

Many plants are fully equipped with our machinery, but if our own organization by extra effort can produce machines superior to those in use, our customers cannot fail to replace their present equipment.

To make this effort requires the expenditure of a good deal of capital because development work is the most expensive work we can do. It is necessary, therefore, for us to lay up a reserve for new engineering and the larger that reserve the better we can realize our desire to produce a product that will insure new orders. That worth-while improvements are just as possible now as they were twenty-five years ago when our association was formed is evidenced by the number of advanced designs brought out recently by firms in our membership. We can all name many firms that have brought out new features: central oiling systems, ball and roller bearing installations, automatic and semi-automatic chucking, air-driven spindles, automatic sizing; and examples arise unbidden in our minds of complete new developments in the grinding machine field, in the field of multiple-spindle continuous turning machinery and in machines with hydraulic feeds.

Some of these firms are carrying on splendidly the fine ideals bequeathed to them by their pioneer founders. We have firms on our roster who have survived the ups and downs of business for periods up to a hundred years; firms whose product has continually improved and kept them in the front rank of our industry. As we look back on what their leaders have achieved we realize that they have set us a high standard and every one of us will have a man's job to live up to it. True, their success was not great, measured in dollars, and neither can we hope for large fortunes to result from our work. We can be proud, however, of what they did to lighten the labors of production and if we can do as much we will, ourselves, enjoy a satisfaction far beyond anything mere money can measure.

Pipe Work in a Railroad Shop

By S. ASHTON HAND
Associate Editor, American Machinist

Bending plate is equipped to handle pipe of all sizes—Bends are drawn to shape by an electrically operated winch—Universal machine for flanging pipe

IN THE Lackawanna shops at Scranton, Pa., the pipe shop has unusual facilities for bending, flanging and miscellaneous work on pipe of all sizes. Most of the devices in use have been made in these shops, and reflect credit upon those responsible for their construction.

The foundation for all bending is, of course, the bending plate and its equipment. The large plate to be seen in Fig. 1, besides having holes in which stakes can be placed for making bends at all conceivable angles, is fully equipped with bending blocks for pipe of all sizes. These blocks are grooved on the backs to fit the stakes, and are hollowed out at the fronts to fit the pipe to be bent. The stakes are of large diameter so as to stand the strain without danger of being bent themselves. All the stakes have rings in the ends so that they can be handled easily.

In bending pipe of small diameter, the bends are pulled into shape by hand, but in large pipe, the electrically operated winch shown in Fig. 2 is used. As can be seen, the winch can be revolved on its base by gearing so that the pull can be made at any angle, and the angle or pull can be changed from time to time as the bending proceeds. The chain leading from the sling on the free end of the pipe can be wrapped around the nigger head of the winch, or in the case of very heavy pipe requiring hard pulling, the connection can be made by a block and fall.

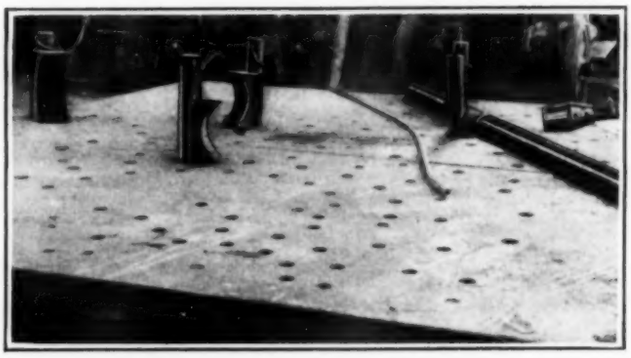
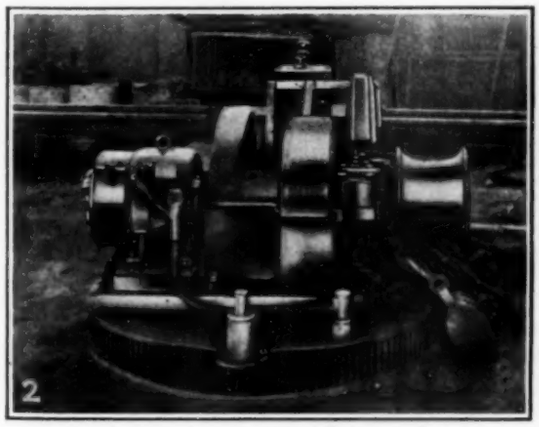


Fig. 1—Plate for bending pipe

In welding steel flanges to the ends of pipe, it is sometimes necessary, especially in replacement work, to have the bolt holes in the flange at one end in a certain angular relation to those in the flange at the opposite end. For such a purpose, as well as for holding pipe while fittings of various kinds are being welded in place, the machine shown in Fig. 3 has been built. The machine consists of a long bed made of rails upon which a pair of headstocks and a pair of steadyrests have been mounted. Both the headstocks have large faceplates to which the pipe flanges can be attached. Attached to the back of each faceplate is an index plate as at *A*. An index pin of the usual plunger type is mounted on each of the heads. It will readily be seen that the heads can be so indexed that flanges fastened to the faceplates can have their boltholes brought into any required angular relation to one another. The steadyrests are used merely as clamps to hold the pipe stationary. In attaching fittings to pipe, the indexing device provides a reliable means of bringing the openings into alignment, or having them "look" at any desired angle to one another. The flanges used are of the Van Stone type. They are drop forged in the smith shop, which is equipped



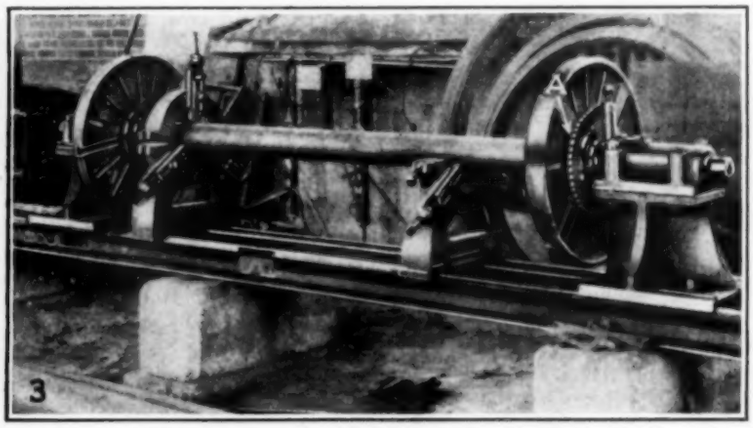


Fig. 2—Electric winch used in pipe bending. Fig. 3—Machine for holding pipe for welding on flanges and fittings

with a full assortment of dies for forging them to fit pipe up to 12 in. in diameter.

After flanges have been welded on the pipe, they are faced in place in a 24 in. x 12-ft. lathe that has been adapted for the work. A facing head having automatic feed is attached to the faceplate. The pipe is carried in two massive steadyrest clamps, one of which is mounted on the carriage, while the other one is clamped to the lathe bed, the tailstock having been removed. The steadyrests are provided with bushings to suit various sizes of pipe. The pipe is held tightly in the steadyrest on the lathe carriage and is a loose fit in the one on the lathe bed. This arrangement permits the pipe to be moved endwise by longitudinal movement of the carriage, so that the flange can be brought up to the cutting tool and adjusted for the depth of cut.

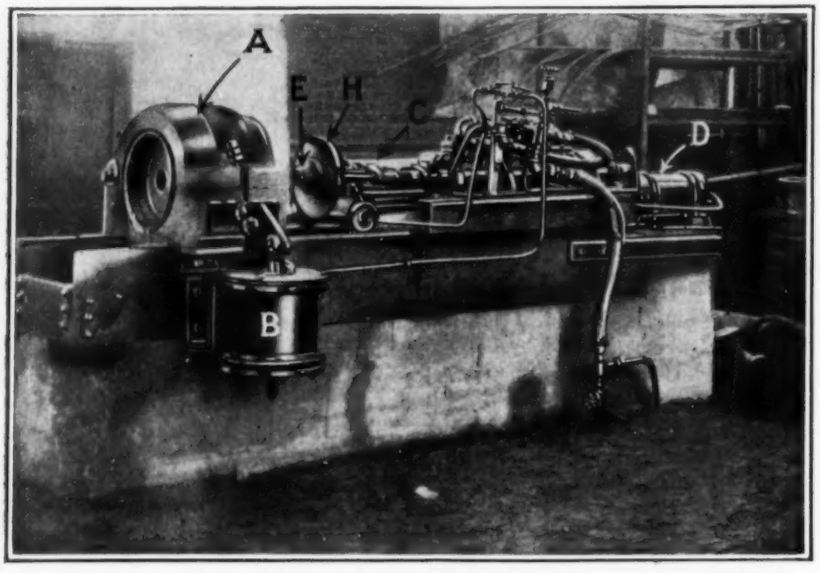


Fig. 4—Pipe flanging machine

A very ingenious pipe-flanging machine is shown in Fig. 4. The clamp *A* for holding the pipe is hinged at the back and is provided with split bushings for holding pipe of different diameters. Pipe from 2½ to 14 in. can be flanged. The clamp cap is opened and closed by a piston in the air cylinder *B*, although the actual clamping being by means of bolts and nuts. The reason for using bolts and nuts for clamping is that the pipe must be held tightly enough to prevent any possibility of its slipping endwise during the flanging operation. Otherwise, an imperfect flange would result.

What appears to be a ram, or plunger, at *C*, is in reality an air hammer. It is mounted on a truck as shown, the truck being attached to a plunger actuated by air pressure in the cylinder *D*. Air applied to one end or the other of the cylinder moves the truck to or from the work.

Expanding or belling the end of the pipe is done by forcing the cone *E* into the end by means of air pressure in the cylinder *D*, using the air hammer as a plain ram. After the end has been expanded, the truck is run back and the cone is removed. The truck is then run forward until the disk *H* bears tightly against the expanded end of the pipe, where it is held by air. Then the air hammer is brought into action, its rapid blows flattening the flange against the end of the bushing by which the pipe is held. Flanges are formed in a surprisingly short time and they present a very neat appearance.

The "Old-Time Machinist"

By William Reid

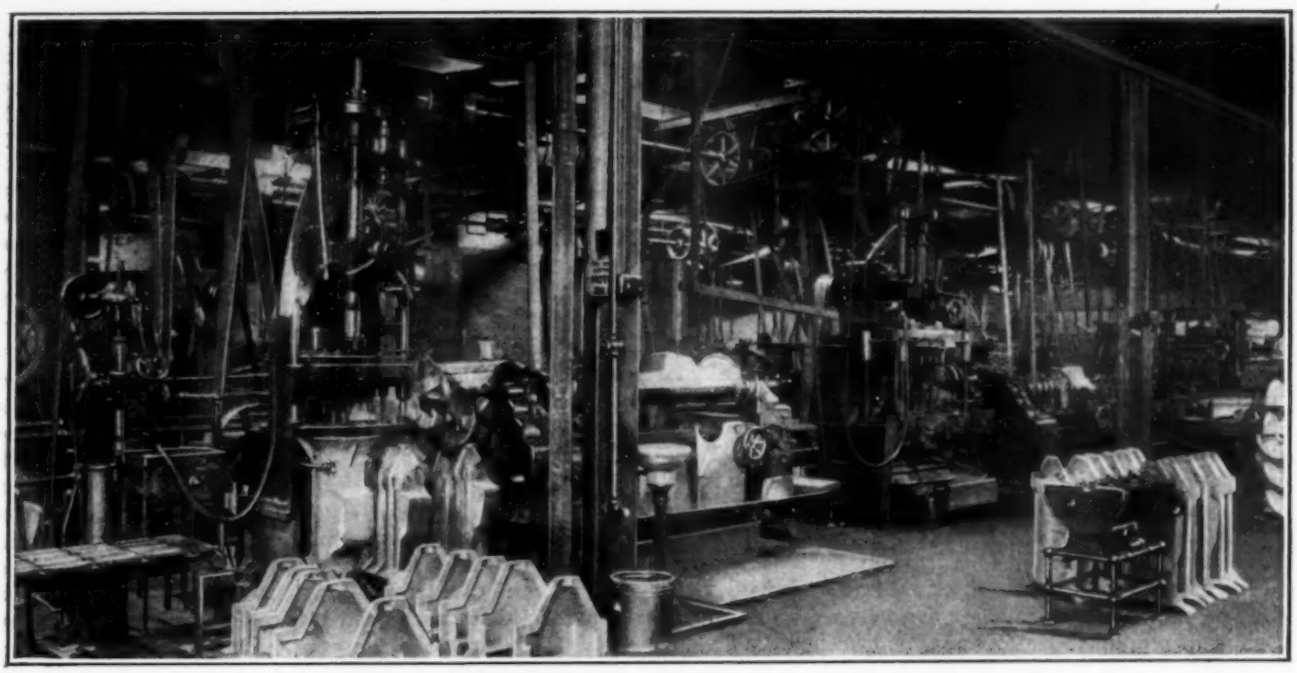
A GREAT deal has been said in the columns of the *American Machinist* about the passing of the old-timer that has a tendency to make one believe such "passing" is in progress or is already a fact. The truth of the matter is that there are as many of the "old-time" machinists alive today as there ever were, if not more. We will always have them with us. I assume the term "old-time machinist" means the "all-round" machinist; the kind that is usually educated in and employed by the small shop. There are in the United States about 15,000 small shops and only about 1,200 large ones; meaning machine shops specifically, not manufacturing establishments where some special machine is built on a production basis. The small shop could not exist if it could hire specialists only, such as tool dressers, lathe-hands, milling machine hands and men who fall under some one of the many similar classifications. The machinist in the small shop is capable of running any ordinary machine tool, or of taking his place at the fitting bench or on the erecting floor. The "all-round" machinist will never get into the "Lo! the poor Indian" class. It is necessary for the large shop to maintain strict discipline; not so the small shop, at least not to the same extent. The middle-aged machinist prefers to work in the small shop, where he can finish the noon-day smoke in the shop, where the owner of the business comes into personal contact with him and calls him by his first name, where he is not known merely as number so-and-so and where he is allowed to feel like a human being.

He is not docked if he is five minutes late, and he is often paid better wages than the man in the large shop. When he seeks employment, he is not obliged to give his family history in order to get a job. He is called upon only to "deliver the goods." In the small shop the machinist must know his trade. In localities like the Pacific Coast where there is little or no manufacturing you will find such men by the hundreds.

The trouble with those who are lamenting the passing of the old-time machinist is that they are operating factories engaged in some special line of manufacture, where they get into the habit of considering every man who runs a lathe or drill press, and wears overalls while doing so, a machinist. Such a man is not necessarily a machinist because he works in a machine shop any more than a clerk or bookkeeper who works in a lawyer's office is a lawyer.

The splendid pages conducted by the *American Machinist* under the heading "Ideas From Practical Men" furnish evidence to my mind that there are still a good many "old-time machinists."

Special, single-purpose equipment often pays big dividends. But when in doubt as to whether to buy special or standard machines—buy standard!



Particles from belting and the agitation of dust-laden air from pulleys and belts produce unusual deposits of dirt on lighting equipment

Maintenance of Lighting Systems Pays

By M. LUCKIESH and E. W. COMMERY
Lighting Research Laboratory, National Lamp Works of the General Electric Co.

Getting full returns on the investment in your lighting system—Dirty windows absorb more than half of natural daylight—Misuse and abuse of the filament lamp

PRODUCTION tests conducted under various intensities of illumination indicate that many industries could benefit by production increases if adequate and properly controlled light were provided and maintained. The difference between 2 and 5 foot-candles of illumination means increases ranging from 12 to 130 per cent in some of the visual functions such as quickness and accuracy of vision. Furthermore, increases in the speed of the various visual functions are not limited to just the lower levels of illumination. In fact, all the visual functions that have been tested at such levels as 100 foot-candles and greater also show definite increases at these higher levels.

From this it is seen that the maintenance of lighting systems is not merely a matter of getting what is actually being paid for, which, of course, is sufficient argument to justify the case, but is also a matter of getting the production that the lighting system is capable of providing.

The general disregard of the condition of lamps, reflectors, walls, ceilings, and windows is due perhaps largely to the commonplaceness of light and to a lack of information. In many places the loss of light from artificial lighting systems ranges from 10 to 25 per cent in four weeks, and where smoke and dust are prevalent this loss may be as high as 40 per cent. The vast expanses of glass used in modern industrial buildings are also subject to dirt accumulation. Manufacturers who would not think of neglecting other essentials in profitable production will let windows and skylights become dirtier and dirtier month after month. The loss from such neglect is not plainly visible but it is a loss none the less. The loss of daylight due to dirty windows has been studied by several investigators. In certain buildings tested, a six month's accumulation of dirt reduced the natural light to one-half the value found when the glass areas were cleaned. The fact that three-fourths of this dirt was found on the inside surfaces is of par-

ticular value. This latter fact indicates that for a given cleaning expenditure a greater amount of daylight can usually be obtained if the interior glass surfaces are cleaned more often than the exterior surfaces. Proof of the enormous light losses due to dirt on windows is easily obtained. Samples of glass recently taken from factory windows and skylights were found in such a condition that cleaning increased their light transmission from 5 to 15 times and in one case 250 times. In terms of loss of production this means many millions of dollars in this country per year.

Depreciation of Lighting Equipment

All equipment is exposed to dust and artificial and natural lighting systems do not escape. The rate of depreciation in light output due to dirt accumulation depends very much upon the location and type of lighting equipment. For this reason a most economic maintenance schedule cannot be set forth which will provide for all cases. It is possible, however, to quickly determine the exact condition of a lighting system. Simple, inexpensive, direct-reading, light-measuring devices, such as the foot-candle meter are now available, which make this possible. Having once determined the amount of light delivered to the workplane when the reflectors are clean, when lamps of proper size and voltage are installed, and when the walls and ceiling are freshly painted, it is possible thereafter to deduce from subsequent readings the relative condition of the entire system. If these readings are frequently made and recorded by some one individual, such as is done with the maintenance of machinery, production will not be affected as it now is for long intervals of time due to neglect.

Removing Dirt

Dirt accumulations generally consist of dry dust, oily or greasy substances and certain compounds that seem to be insoluble in the usual cleaning compounds. Wiping with a dry cloth removes from one-half to two-thirds of the dirt that is easily removed with a damp cloth. A damp cloth removes a large part of the more usual forms of dirt encountered; however, the lighting equipment should be thoroughly washed every second or third cleaning period. Dirt which is removed with difficulty when using soap and water or one of the household cleaning compounds is generally soluble in denatured alcohol, benzol and other familiar solvents. Their inflammability necessitates caution with their use.

Lighting equipment employing ventilating holes invariably shows a higher rate of depreciation than those without. This is particularly true with inclosing globes. The bottom vent-hole so prevalent with this type of equipment produces dirt accumulation two to three times faster than when the lower vent-hole is absent.

There is a depreciation in light output from a clean electric filament lamp with hours of operation. This is not very serious during the normal life for which the lamp is designed, but many lamps remain in service long after their normal life. These lamps may cause considerable depreciation. Lamps must be operated at rated voltage, if the designed efficiency is to be obtained. The loss of light resulting from burning lamps under voltage greatly exceeds the reduction in wattage that is effected. Readings of the voltage at the sockets with the lighting load on provides a satisfactory check on this item.

It is not uncommon to find in use lamps of incorrect size for given reflectors. This procedure can effect appreciable losses with some of the open types of industrial reflectors. The likelihood of this occurring can be minimized if the reflectors are marked so as to indicate the proper size of lamp that should be used.

The reflection-factor of walls, ceiling and machinery plays an important part in delivering light to the workplane. Walls and ceiling can influence lighting in so far as they have an opportunity and this is a matter of the percentage of the total light which is incident upon them. With porcelain-enamelled direct-lighting reflectors little light reaches the ceiling directly so that the reflection-factor of the ceiling is of little importance, although it is of great importance in the case of daylight from the windows. The reflection-factor of the walls is important in small rooms inasmuch as a considerable proportion of the light reaches these surfaces directly. As the size of the room increases correspondingly less of the total light falls directly on the walls and, therefore, from the artificial lighting standpoint, it would appear that the maintenance of these surfaces is unimportant. However, the close visual operations are generally located along these walls having windows and for this reason good reflecting surfaces are desirable to conserve the light where it is needed the most. The painting of machinery can do much toward reflecting light on the work and particularly in shadows. For example, the illumination of the table of a vertical slotter equipped with a local lighting-unit was increased 75 per cent when the surfaces of the machine adjacent to the table were painted white. Further, the sharp shadows were materially reduced. In general, white for all machinery would create an insufferable condition; however, if a subdued gray which reflects 25 to 50 per cent of the light is used, much light would be saved by reflection.

Keeping a Cleaning Schedule

A profitable schedule for cleaning can be determined without much difficulty in any given case. A foot-candle meter should be a part of the equipment of the larger factories. The data on the relation of lighting to production are available. By means of these data, it is easy to relate illumination intensities to production. By converting production into profits, it is certain that the management of any factory or any place where persons work for pay and are paid for profit, will see that a good lighting system, properly maintained, is one of the most satisfactory and profitable entries on the payroll.

Cleaning Clogged Files—Discussion

By James McIntosh

THE article by Leonard J. Kaufman under the title given above, and published on page 535, Vol. 66, of *American Machinist*, calls to mind the old reliable method of filling the teeth of files with chalk to prevent them from retaining the filings. Just draw a piece of chalk over the surface of the file in the direction of the cut, so that the spaces between the teeth will be filled with the chalk dust, and the anchorage for the filings will be so poor that they may be dislodged by a slight tap of the file edgewise upon the vise or other solid object.

A file so filled will not tear the surface of the work upon which it is used, nor will it become clogged with filings, regardless of whether it is used upon a flat surface in the vise or a round piece in the lathe.

Training the Owner's Son

By W. A. VIALL
Vice-President, Brown and Sharpe Manufacturing Co.

Turning over the business to the son is a natural ambition—Selecting a teacher and laying out a training course

A FRIEND of mine said recently that in his opinion many owners of businesses were much interested in the matter of educating their sons or some member of their family to follow in their footsteps, but that they were at a loss to know whether or not they were pursuing a proper course of training. Very much thought and attention has been given to the training of apprentices looking forward to the carrying on of our businesses. We have had committees on this subject, and there have been some results. The National Metal Trades Association has gone still further and developed a practical plan for the training of apprentices, as well as special workers and operators. Furthermore, they have realized the necessity of training their foremen, and so the training work has been progressive. It is a natural and laudable ambition for a father to desire to have a son enter and carry on the business with which he has been identified, if it has been a successful one.

Training a member of the family to take over the business sometimes presents greater problems than the training of outsiders. Mr. Viall shows from a long experience how this can be done with good effect on the boy and also on the employees

Many fathers have labored and planned such a thing for the son. But even with the best of will, does the father know just what to do? There has been no research made on this subject. It is not possible for anyone to lay down a plan that would cover all cases, and I shall not try to do the impossible by prescribing a course, but shall try to give the results of observation and experience over a period of more than thirty-five years.

It is taken for granted that the young man has had proper home training, that he is amenable to home influences and has a mentality sufficient to give serious thought to the question of his life's work. It has also been my theory that every boy should have at least a high school education. The question then arises whether or not it is best for the boy, and best for the business, to have him enter it.

Probably the average boy has no marked predilection toward his life work by the time he has finished high school, but if he has by this time developed some real inclination for art, music, trading or preaching, and shows a strong distaste for business, it is wrong to try to push him into a channel that will make him work all his life with a dislike for his occupation. At this point it is also necessary to decide whether the boy will go into college or enter the business at once.

If the boy is willing to work in college for the training that college will give him, he should by all means enter and take a course that will give him a liberal education in mathematics, economics, science, literature, and languages, such as will make him a broad man. In this, I am considering the man who is planning to enter business as a future leader of it, and not the man who is planning to be an engineer, who may later gradually work into the executive end. In this, also, I have purposely avoided a suggestion of college shop work or of technical training. When a university education accomplishes its purpose it has taught a man to think for himself, to concentrate on the matters in hand, and to act intelligently. The question as to whether or not it is good for the business to have the son enter would have to be decided on its merits. There are cases where an organization has been built up in such a way that the interests of a member of a family looking forward to taking control would completely destroy the work of many years, and in that case, unless the prospective leader is going to be willing to work his way in through the ranks, trouble is apt to arise as time goes on.

Given the case, however, where conditions all tend toward the young man going into the business, I believe that the training should have two main objects: First the knowledge of the business in its various branches, and second, a knowledge of men. The chances are that the young man has been brought up in a class entirely different from those whom he has to meet in the shop and with whom he must work, but he must meet them at first hand so that he may learn their language and their ways of thinking. It is questionable if the father is the best instructor for his son, or whether it is for the best interest of all that the son be placed in charge of a man who knows how to train men, and who is in sympathy with the task in hand. A father would either be inclined to be more severe and exacting with his son than with another to show his

Paper presented at the Spring Meeting, National Machine Tool Builders' Association, West Point, May 10-12.

lack of favoritism, or else, governed by the soft heart of the mother, who feels her boy should have an easy time, he might allow him to slide over part of his training that the boy really needs.

The young man should be guided by one who will not allow him to be a subject of adulation on the part of employees, nor on the other hand to have him put upon because he is the owner's son. Either of these things can very easily happen unless the young man himself has an extraordinary degree of sense of proportion. In other words, he should be one of the regular employees during his term of training.

In the case of the son who goes first to college, I have left out the question of technical training, because I think that this training should be obtained under practical working conditions of the shop in which his life is to be spent. Some fathers will object that boys do not like to do manual labor, that it is not the fashion among their companions, but when a boy has an instructor of the type that I have mentioned, the latter will be able to make the young man see the usefulness of the procedure and to create within him a vision that will carry him over the bumps.

Two years in actual shop practice would not be too long for obtaining what I think the young man should have. Following this he should have a term in the drafting room, taking up work that would give him facilities in reading drawings readily, and at the same time he should have an opportunity to get an insight into the method pursued in carrying through a piece of work. He should also be given an idea of the accounting and other systems of the plant.

After this practical line of training, it is an excellent plan to place the young man as a sub-foreman on some job that will require executive work to carry on. It will give him a taste of actual shop conditions, and here he will have a chance to try out in a small way his possibilities as a leader. Such a course as this will not make him a machinist nor an engineer, but will develop his talent for comprehending processes, evaluating the use of tools, and above all will bring him into close contact with men, giving him an angle upon the work that can be obtained in no other way. I have seen young men who have gone through such a course as this take their places as executives in the works, and when later problems of the shop were brought to them were able to discuss them from the point of view of the shop man who understands the details of what he is talking about.

During these years of shop experience it would be well to have the young man make a few well planned trips to other manufacturers, and on the completion of his work, before taking a responsible position that may have been planned for him, a trip abroad would be of great help. He would there see other ways of manufacturing, and get points of view which would broaden him and make him still more helpful in his position.

In all of this work, I have in mind three specific ends. The first of these is a working knowledge of the details of the business both in its mechanical operation and in its executive line. The second is discipline. I firmly believe that no man is equipped to undertake the charge of help unless he himself has undergone a thorough training that involves discipline. During his shop training the young man will have had occasion to observe the necessity of proper discipline, and his own obedience to it is a necessary preparation for his life work. Finally, a knowledge of men through personal contact is necessary. I stress this point because I place such importance upon it.

Some may demur at having a young man of this generation go through the details of the daily work. In our industry most of the concerns were founded by men who in their early days worked for years at the bench or the drafting board, and gradually emerged from it as their dreams became facts. The amount of time that our present young men would give would represent a very small part of the physical work that the father went through.

We are inclined to think that times have changed, but in reality the thing that is bothering us is that we are individually living on a different plane today than when we started life, and we dread putting the young man through the hard experience. But competition grows keener as we go on, and those who are to take the responsibility must be prepared to meet this keener competition, to say nothing of the many problems that are constantly arising in the labor situations that are changing almost monthly.

Musings of An Old Timer

JIM DOE is the fastest all-around workman in the shop. The boss knows that, so Jim usually gets the rush jobs.

Monday morning the boss handed Jim a fair-sized job bearing a tag marked RUSH in big red letters.

Jim worked his head off all day to get the job out and had to work overtime till ten o'clock to finish it.

Two weeks later this job was seen loitering on the floor in back of the boss' desk. "What's all the rush about?" Jim wants to know.

This happens quite frequently; in fact it's getting to be an old chestnut. Jim got quite peeved about it this time because he wanted to take in the show the night he had to work.

Says he's going to quit because he's getting unpopular with the boys.

They all have to turn out more work for the same pay since the boss started this scheme. Jim seems to be the goat, since they say he is killing the job.

Now getting out a rush job is no picnic, especially when all the profit goes to the company. We think a man who can hit the ball should get a bonus or some incentive for his efforts.

If we finish a job in a hurry and make a practice of rushing everything, the rest of the gang puts up a holler and says we are killing the job.

If we don't get it out in good time, the boss gets a grouch and may let us go.

When we do finish a job in good time and turn it in, the boss often lets it lie around for a week or more before it is used or someone calls for it.

That gets our goats, and Jim says the boss needs to get a new alibi.

Automotive Production

Cylinder-Block Methods on the Pierce-Arrow "80"

By Fred H. Colvin
Editor, American Machinist

Experience with surplus equipment-capacity has exploded one of the old theories of economical production that no machine should be installed that cannot be kept continuously busy

THE introduction of the smaller Pierce-Arrow car, known as Series 80, brought new problems on account of the production rate desired—50 per day. The equipment is of particular interest as an example of modern thought in management. For, in order to get an efficient line-up, it was necessary to purchase machine equipment that gave excess capacity. This was, however, considered to be a greater economy than to shift set-ups or change operations, as would otherwise be necessary. In other words, this line-up explodes the old notion that machines not always in use mean poor management and waste. The experience at the Pierce-Arrow plant indicates that there are many cases where it is cheaper to have an excess of machine equipment, some or all of it standing idle a portion of the time, than to shift operations in order to keep all machines at work all the time. The difference is not alone in machining time but in the lessened assembly time due to greater accuracy. This is a point that must be carefully studied in order to secure the greatest real economy of operation.

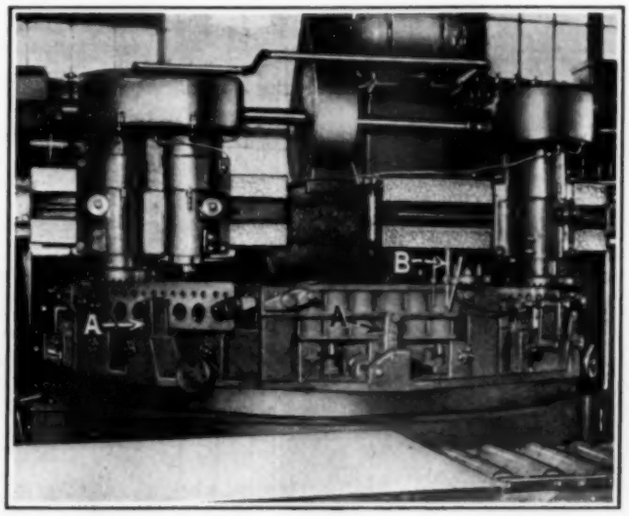


Fig. 1—Milling all four sides of cylinder block

Conveyors are very much in evidence all along the production and assembly lines, as can be seen in the different views. Cylinder blocks are milled on top, bottom and sides on the Newton rotary machine shown in Fig. 1. The fixtures are alternated to suit the operations, the blocks being reversed in each fixture so as to mill the opposite ends or sides, as the case may be. The fixtures are provided with adjustments for the roughing and finishing cuts. Stops *A* swing down out of the way for loading and unloading, and clamps are conveniently provided with capscrews that are handled by the key wrenches at *B*.

Next, both flanges are drilled in the multiple spindle machine in Fig. 2. The clamp arm *A* of the fixture can be swung up out of the way and held by swinging the hookbolt *B* over the short arm at the upper end. The T-headed bolt *C* holds the lower end when the block is to be clamped. A screw controlled by the handwheel *D* clamps the upper end of the block and also centers it. The ends are held by the sliding clamps *E* that are locked by the cam levers at *H*. Cylinders are bored in the Foote-Burt machine, Fig. 3, being located by two reamed bolt holes as is usual. The locating dowels are controlled by the lever *A*. Blocks are clamped by levers *B* and *C*. Further drilling operations are performed in the same line, some of them being shown in Fig. 4, where valve openings, valve stem holes, etc., are drilled as the block goes down the line. After studding, the block is ground and then goes to the honing operation, Fig. 5. The block is located by dowels, and the six bores are indexed by the plate *A* and the stop *B*. The hone is guided by the plate *C* which clears the studs and supports the collar above the hone. The hone is fed by hand, the type of head that can be expanded to a given diameter, being used. The cylinder surface produced in this way has proved very satisfactory.

Automotive Production

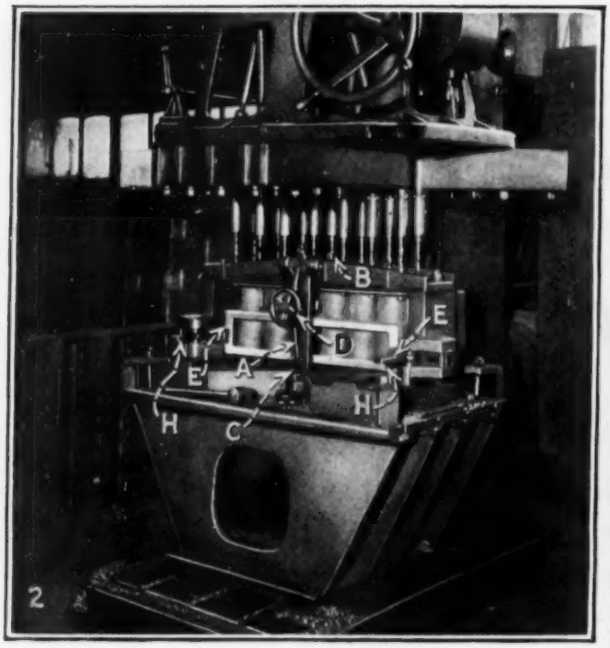


Fig. 2—The flange holes are drilled in the multi-spindle machine shown in this illustration. The cylinder blocks are held by quick-acting clamps

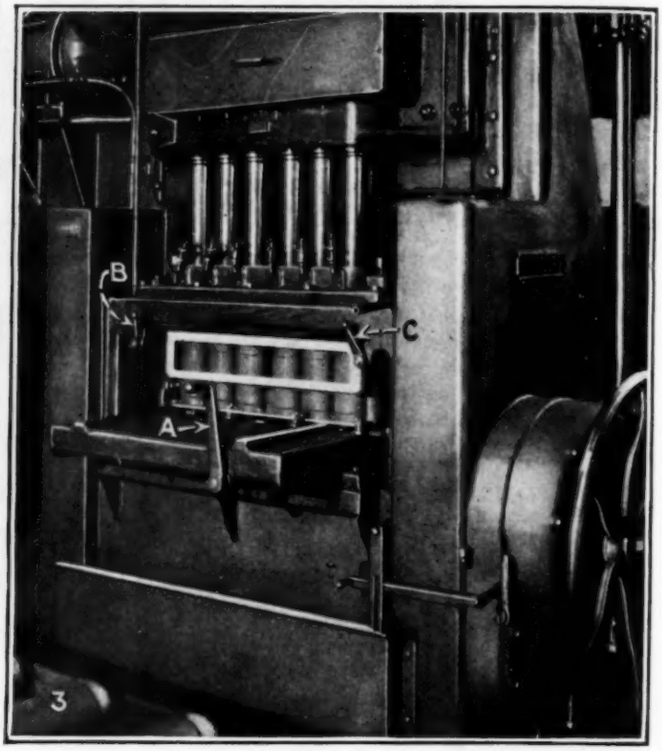


Fig. 3—Cylinders are bored in six-spindle machines, the blocks being located by dowels

Fig. 4—Valve openings, valve-stem holes, etc., are drilled as the blocks pass down the line

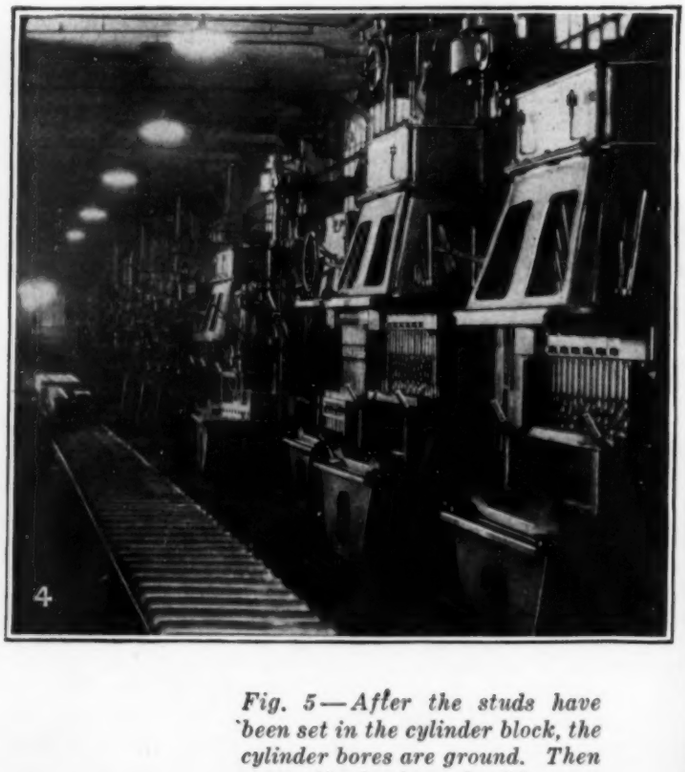
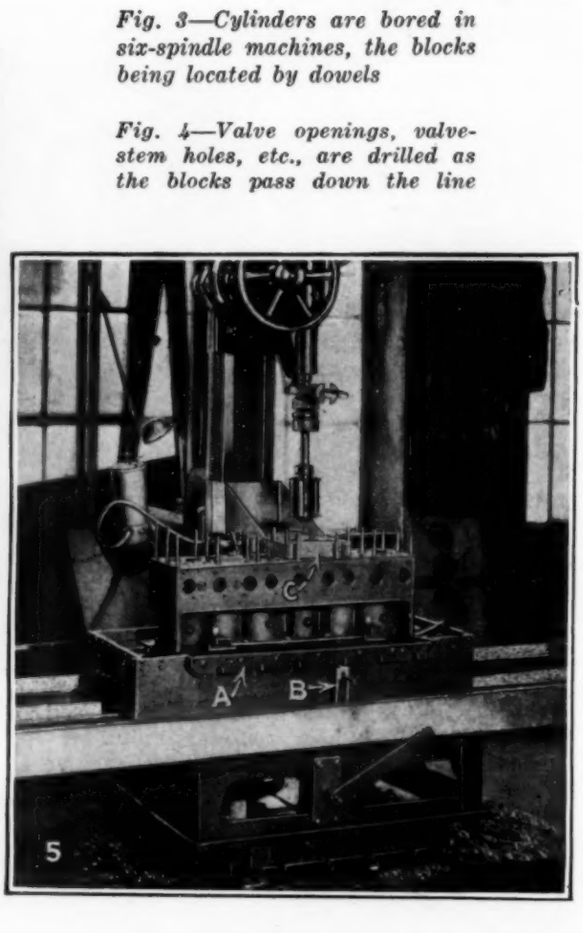


Fig. 5—After the studs have been set in the cylinder block, the cylinder bores are ground. Then comes the honing. In this operation the hones, which are of the expansion type, are fed by hand



Bethlehem Torque Amplifier

A device for controlling accurately with a small expenditure of energy various types of mechanical motions

THE Bethlehem mechanical torque amplifier (Nieman patents) recently developed by the Bethlehem Steel Company is a mechanism provided with a control shaft at one end and a work shaft at the other, the control shaft requiring only a feeble torque to operate it in either direction, while the work shaft yields a torque of sufficient amount to accomplish any purpose desired, at the same time accurately following the control shaft in all its angular movements. Its broad purpose is to perform the functions of an electrical or hydraulic servo-motor, but so different are its operating characteristics that it should be considered as an entirely new type of control apparatus.

There are three elements to the torque amplifier: "work shaft," "control shaft" and "drive shaft." The drive shaft is driven by any outside source of power, such as an electric motor, and revolves continuously in one direction, a single motor being capable of operating a number of different amplifiers whose operation is entirely independent. The control shaft is actuated by any mechanical or manual control means, or by such weak forces as can be delivered through electrical recording instruments or telemetric transmission systems. The work shaft is directly coupled to the work to be done, as for instance the elevating or training gears of a gun, a ship's rudder or the steering wheel of an automobile. The control shaft can be freely revolved in either direction, with only a small amount of effort; the work shaft maintains at all times its anguiar synchronism with the control shaft, and in addition exerts a heavy torque to overcome outside resistance.

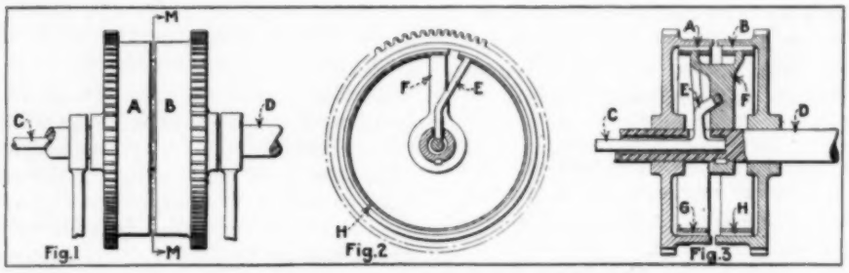


Fig. 1—Simple form of torque amplifier. Fig. 2—Section M-M through Fig. 1. Fig. 3—Longitudinal section through Fig. 1

The lag between the work shaft and the control shaft is so small as to be inappreciable in any practical application. Measured in angle it never amounts to more than a degree or two of arc, and this is true even if the control shaft is actuated in the most erratic manner; that is, with sudden changes in speed or quick reversals of direction. It is, in fact, utterly impossible by any means, even if the outside source of power is shut off, to get the control and work shafts out of step. The work shaft follows slow or rapid motions of the control shaft with absolute smoothness, and the internal parts of the apparatus operate noiselessly. The device has a definite maximum speed, depending on the speed of the drive shaft. If attempt is made to revolve the control shaft fastener than this maximum speed, it will meet with a positive resistance which will hold its speed down to the maximum regardless of the torque applied.

Unlike other forms of servo-motor, there is always a definite ratio between the torque applied at the control shaft and that delivered at the work shaft, this ratio being known as the "amplification." This ratio may, however, be made as high as desired. In devices already constructed it ranges, according to the design, from 1:10 up to 1:50,000.

Fundamentally, the torque amplifier consists of two oppositely rotating drums provided with friction bands which may be brought into contact with the drums through actuation of the control shaft, this frictional contact causing the friction bands to exert pressure on the work shaft. The force applied to the control shaft is thus enhanced, or amplified, when it reaches the work shaft by the extent to which the bands are urged forward because of their frictional contact with the rotating drums. In its simplest form the amplifier is shown in Fig. 1. Two oppositely rotating drums *A*, *B*, are driven by a motor, not shown, through gears integral with the respective drums; *C* is the control shaft and *D* the work shaft. Fig. 2 is a section through Fig. 1 at the line *M-M* and viewed in the direction of the arrows; while Fig. 3 is a longitudinal section through both drums. The control shaft *C* is concentric with work shaft *D* and is supported by a socket bearing in *D*. Integral with *C* is the forked control arm *E* which passes through a hole in the side of hollow shaft *D*, the size of this hole being sufficient for clearance and to allow a considerable angular movement of *C* in relation to *D*. Keyed to *D* is work arm *F*, also forked.

The friction bands *G* and *H* fit inside the drums *A* and *B*, respectively. These bands have sockets at each end, one socket of each band engaging with a stud on the work arm *F*, the socket at the other end of each band engaging with the respective ends of the control arm *E*. The bands are disposed in opposite directions in the two drums so that in each drum the band extends from the control arm around to the work arm in the direction of rotation of that drum. It follows that if the control arm is revolved in a given direction it will expand and tighten the band which lies in the drum rotating in the direction of the movement given to the control shaft, at the same time contracting and loosen-

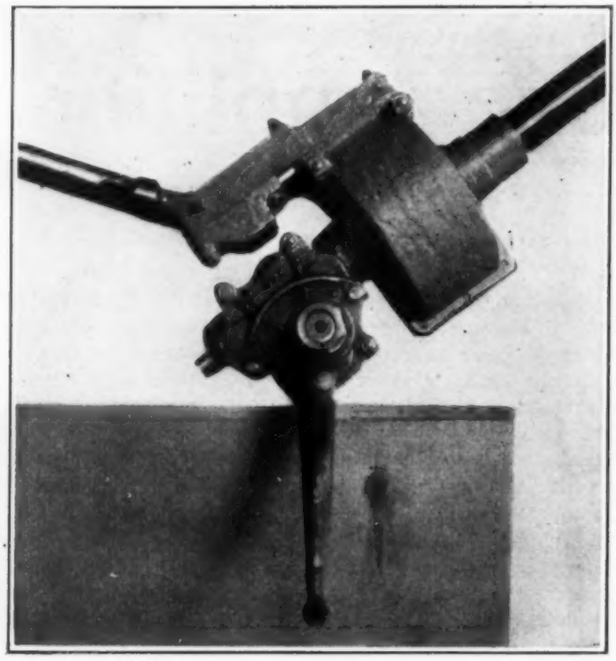


Fig. 4—Torque amplifier on automobile. Spark and gas controls pass through amplifier and emerge at end of steering column. Drums are driven from engine connection. The steering gear proper may be left undisturbed or the ratio reduced

ing the band in the opposite drum; therefore, the work arm, because of the frictional engagement of the band in one of the drums is pushed around by that band in the direction of the drum's rotation.

Moreover, the force with which the band presses against the work arm stud is many times the force applied at the control arm stud. This follows from the well-known principle of wrapping friction, commonly used in calculating belt drives, snubbing problems, etc., and equally applicable to an outside band frictioning against the outside of a drum and to an inside band frictioning against the inside of a drum. The formula is usually expressed:

$$\frac{F_1}{F_2} = e^{\mu a}$$

Where F_2 and F_1 are the forces applied respectively to control and work ends of the wrapping friction member, e is the base of natural logarithms, μ is the coefficient of friction, and a is the angle of wrap in radians. It is to be noted that this formula does not mention the diameter of the drum or the width of the band, these factors being immaterial to the theory. In the case of the amplifier shown we can assume a coefficient of friction of 0.6, an angle of wrap of a little less than a full circle, say six radians, giving a relation of F_2 to F_1 of about 40 to 1.

The action of the work arm in following the movements of the control arm can be understood from the following consideration. Observing only drum B as shown in Fig. 2, if the control arm E is moved to the right by an infinitesimal amount, the band which was originally barely in contact with the drum, is now put into frictional engagement with it. This forces the end of the work arm also to the right, the movement of the work arm in this direction tending to loosen the band, so that when the work arm has followed the control arm through exactly the same angle the band again reaches the condition of being barely in contact with the drum. If the movement of the control arm is a continuous one to the right then the work arm follows continuously so that the tape is always maintained in bare frictional contact with the drum.

In the foregoing it was assumed that the work arm moved with perfect freedom. If, however, the work shaft is doing external work it lags behind, thereby tightening the band until sufficient frictional contact is obtained to overcome the external resistance. The amount of such lag depends on the nature of the friction material. If a very spongy substance were used for this purpose, the angular lag would be considerable; but in the case of nearly incompressible friction materials it is so small as almost to escape detection.

The difference between a band which slides freely within the drum and one which grips with a heavy friction is only a matter of 0.001 in. in radial expansion or about 0.006 in. expansion between the ends of the band. Special attention must be called to the fact that the speed of the drum has no relation to the speed of the band and connected parts except that the drum speed must always be higher than any speed at which it is desired to rotate the control shaft. In the normal operation of an amplifier the bands are intended to be in floating frictional engagement with the drums and never to grip them positively.

The fact that the friction is of this floating type accounts for the fact that even with high drum speeds the control shaft may be revolved at a very slow speed while the work shaft executes the same slow movement with perfect uniformity. Such an amplifier as described above can be controlled in either direction, the torque furnished by the work shaft being always forty times that supplied by the control shaft, this "ratio of amplification" being theoretically constant for torques of any magnitude and practically so over a wide range of conditions.

A practical difficulty is encountered in constructing an apparatus as above described because of the necessity of accurately adjusting the lengths of the bands so that in reversing the direction of the control shaft the band on one side shall begin to grip just when the band on the other side releases. If the bands are made too long, both will be gripping at the same time whereas if too short there will be a neutral space when neither grips. To avoid this exceedingly close tolerance and alterations in service due to heating and wear, a floating automatic adjustment (the lashlock, which will be described in a later article) has been provided at the end of the work arm to keep both bands in light frictional contact under any condition. Thus particular care is necessary to make both bands of exactly the same length. If one happens to be longer than the other it causes a slight angular displacement between the power and control arms, an error which being constant and always in the same direction automatically cancels out when the amplifier is initially set. If, after the mechanism is adjusted and calibrated, wear occurs in both bands equally, the backlash adjuster automatically takes it up without altering the adjustment.

For purposes where an amplification of 40 to 1 is not sufficient, the desired degree of amplification might be obtained by using a number of amplifiers in series, the work shaft of the first being connected to the control

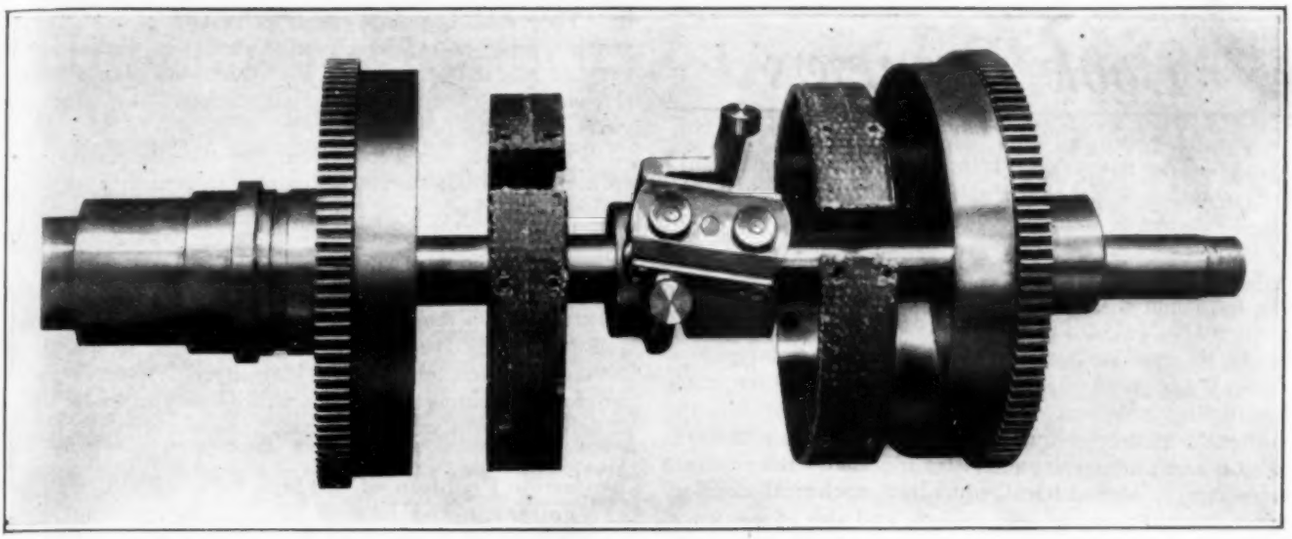


Fig. 5—Automobile amplifier with housing removed, showing friction bands, control arms and "lashlock" for eliminating backlash. The assembled unit is shown in Fig. 4

shaft of the second amplifier, and so on, the work shaft of the final amplifier performing the required work. Each amplifier in the series will multiply the torque it receives by 40. Thus, with two amplifiers the ratio of amplification would be 1 to 1,600; with three the ratio would be 1 to 64,000, etc. In actual design amplifiers are built in "stages," the first friction band contracting on the hub of a drum and the second expanding within the outer flange of the same drum; while the third band and the fourth contact similarly with a second drum. The bands are hooked together through a system of simple linkage. Two types of amplifiers are shown in Figs. 4, 5 and 6.

In amplifiers of certain types a spring may be used to perform the drive in one direction, either directly (in which case the torque on the work arm is limited, in that direction, to the strength of the spring) or by actuating the control of the final stage of a multi-stage amplifier (in which case the torque in both directions is unlimited in amount, to all intents and purposes).

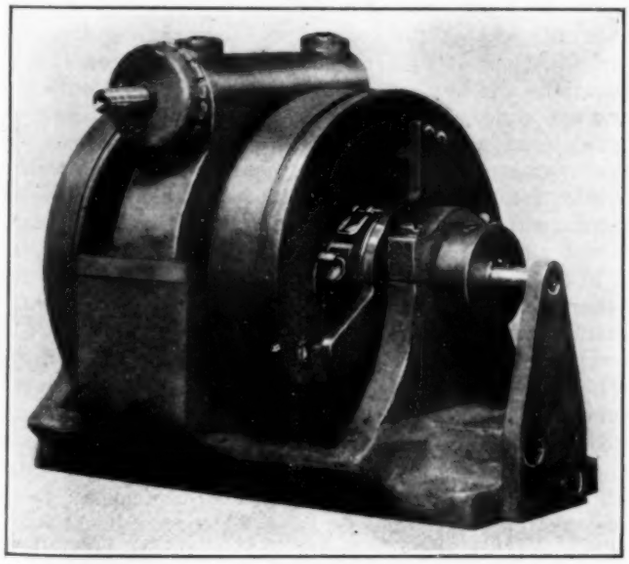


Fig. 6—Service amplifier, a light duty type, adaptable to computing machines, distant control of rheostats and similar situations

Possible uses of the torque amplifier include such a range as automobile and ship steering, gun turning, train, switch and signal control, control of steam systems, running of tower clocks, operating valves, opening or revolving doors, metering devices, governors, various machine tool mechanisms, and regulation of roll speeds in steel, paper and textile mills.

Dimensioning Drawings—An Art—Discussion

By D. P. Muirhead
Glasgow, Scotland

On page 327, Vol. 66, of the *American Machinist* there is an article on the above subject by James McIntosh, with whom I disagree on several points.

Evidently he has not got a very good opinion of the average draftsman's drawing, as he states that, even though the drawing is complete with a specification of materials and notes as to the degree of accuracy required, together with complete machining instructions, such a drawing is fit only for hanging on a wall. It evidently has no practical value in his eyes. I think he is taking a very narrow view of this matter, as it is obviously impossible to make a drawing so complete and foolproof, that there would be no possibility of someone making a blunder.

It is also stated in the article, that the drawing should be checked up in every department through which it must pass in order to qualify for the standard stated. This also appears to me to be a waste of time, and no modern engineering firm would permit this procedure in the shops. Those in authority would rightly argue that a drawing should be correct before it leaves the drawing office and that it should convey all the necessary information to the operator in the shop.

The value of working and inspection limits is also pointed out, but these again may be quite unnecessary, as it depends on the product of the firm and the number of parts being manufactured. Limits and inspection are necessary only under certain conditions.

Book Reviews

Wings—The Story of Flying. One hundred eighty pages, 6x9 inches. Published by the Aëronautical Chamber of Commerce of America, Inc., New York City. Price $5.25.

This volume gives a very comprehensive outline of the development in all branches of aviation during the past year. In addition to a mass of data of various kinds it contains nearly 100 illustrations, largely of various types of airplanes, but also including other interesting subjects. The book gives a concise and authentic history of aviation to date, including Governmental and commercial activities together with chapters on airways, aëronautical education, technical development, aircraft and engine design, and the aëronautical industry in general. No one who is at all interested in the development of aviation, whether it be from the commercial end or from the manufacture of airplanes or any of their equipment, can fail to find this volume of value. It is one that will be referred to many times during the coming year.

Benjamin Garver Lamme, An Autobiography. Two hundred seventy-one pages, 6x8¾ in., cloth boards. Illustrated. Published by G. P. Putnam's Sons, New York City. Price $3.

This book is unique in its field. Antobiographies that tell stirrring tales of battles and political careers are numerous, but this one consists of the simple homely details of an engineer's life, with intimate glimpses into a mind completely absorbed in the problems of everyday manufacturing. Mr. Lamme was primarily a designer of electrical machinery, and in this book he has attempted to lead his readers through the processes of thought that culminated in the invention of such machinery as the great generators at Niagara. It is not a book that would appeal to the average man in the street, but one from which the young engineer who hopes to do big things in his profession can gain much inspiration. It is the story of a man who from a comparatively simple start rose to stand for 21 years as the Chief Engineer of one of the largest electric machinery manufacturing companies, and from whose brain and hand many of the modern developments in electric machinery can be traced.

Vacations for Industrial Workers. By Charles M. Mills. Three hundred twenty-eight pages, 5¾x8¼ in. Published by the Ronald Press, New York. Price $5.

The fact that vacations for workers have reached the dignity of being made the subject of a book is indicative of the changes that are taking place in industry. This volume gives the results of a survey that indicates a more extensive granting of vacations with pay than might be expected. While vacations with pay were first given by individual employers in Europe, this practice is now insignificant in volume. In this country, however, company officers are taking a more active part in the matter than the employees themselves.

Of the phases studied, 199 were in the United States, the 22 others being in 5 foreign countries. Of those who have tried the plan, but 6 per cent have abandoned it. The most common vacation is one week after a year's employment, lengthening to two weeks after varying lengths of service. One European plan extends the vacation to three weeks with double pay, after 30 years of service.

As might be expected there is a wide variety of opinions as to the advisability and workability of such plans. Some managers feel that it decreases production, largely because workers will not go to the country or secure a complete change of scene. Others feel that it helps the men in various ways. Workers in tropical countries have long had extensive vacations, with pay and frequently traveling expenses as well, to get them into a different climate periodically. Whatever one's opinion, all managers of men will do well to know what is being done in various parts of the world.

Economic Problem of Modern Life. By S. Howard Patterson, and Karl W. H. Scholz, Assistant Professors of Economics at the Wharton School of Finance and Commerce, University of Pennsylvania. Six hundred fifteen pages, 6x9 in., cloth boards. Indexed. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price $3.

This volume, while primarily a textbook, is a most complete treatise on the problems of industry that have to be met in the everyday affairs of the business man and manufacturer. Throughout the book there is no tendency of one-sidedness, but such difficult subjects as industrial relations, collective bargaining, and socialism, are dealt with in a fair and open manner.

The book is divided into five main parts, dealing systematically with economic organization, monopoly, exchange, public finance, labor and industrial unrest. Although social science should be an intensely interesting subject to men of business who exercise control over the lives of large numbers of workmen, it is seldom presented in a way that can be grasped readily by the average busy executive. The authors of this book, however, have digested a vast amount of information, and presented it in a concise, progressive, and highly interesting manner.

The first part consists of five chapters, dealing with such subjects as the control of industry, development and functions of exchanges, speculation, insurance, corporations and business finance. Part two deals with old and new concepts of trusts and monopolies, and laws and regulations governing monopolies. In part three is given an outline of the nature and characteristics of money, functions of various kinds of banks and investment systems, business cycles, foreign exchange, and investments.

For the average business man who wants a comprehensive outline of public finance, revenues, taxes, and tariffs, part four is especially valuable, as it gives a comprehensive view of these public problems without the usual burdensome figures. But probably the most important feature of the book as regards the executive problems of today is part five relating to labor. In six chapters it takes up industrial unrest causes, standards of living, economic inequality, social insurance, unemployment, old age pensions, labor legislation, profit sharing, and labor and employers' organizations. The book should be a valuable addition to the library of every executive and can be read profitably by anyone having to do with industry or commerce.

Influence of Elasticity on Gear Tooth Loads

WITH elastic materials, there is always some deformation in gears under load. This deformation would be made up partly of bending of the teeth and partly of compression of the material at the contact area. Since the contact travels over the entire active surface, the bending varies because the load is applied at different distances from the base of the teeth. Secondly, at certain periods two or more teeth are sharing the load, while at others, only one tooth is carrying the load. At low speeds, where the effect of inertia is small, variations in velocity of the driven gear would approximate the variations in static deformation, but as the speed is increased a balanced condition is reached where inertia effects are sufficient to cause a uniform deformation of the tooth profile at all points of contact. The gears, assuming them to be geometrically perfect, would then travel at a constant speed, although a variation in load would be present, equal to the difference in the static load required to distort all points of the profile equally.

A formula for calculating the distortion due to compression at any point has been developed by S. Timoshenko and R. V. Baud, as follows:

$$d_1 = 2\,\frac{1-m^2}{E} \times \frac{P}{\pi}\left(\frac{2}{3} + \log \frac{1.548E}{P}(r_1 + r_2)\right) \quad (1)$$

where m = Poisson's ratio of strain

E = modulus of elasticity, lb. per sq.in.

r_1 and r_2 = radii of cylinders in contact, in.

P = load per inch of face, lb.

The radius of curvature on an involute-tooth profile varies at each point, but the sum $(r_1 + r_2)$ of mating profiles is constant and is equal to the center distance multiplied by the sine of the pressure angle. But even when this sum is varied over a wide range, there is little change in the value d_1; hence the expression $(r_1 + r_2)$ can be safely ignored. Also when different values of E are substituted in the equation, it is found that d_1 is approximately inversely proportional to E. Hence equation (1) can be approximated thus:

$$d_1 = \frac{7.25P}{E} \quad (2)$$

The equation for bending of a cantilever beam of variable depth is highly complicated, but by introducing approximations a simpler form can be obtained.

$$d_2 = \frac{0.242P}{yE} \quad (3)$$

Where y = Lewis form factor.

The total effective deformation d_t is the sum of equations (2) and (3) or

$$d_t = d_1 + d_2 = \frac{P}{E}\left(\frac{0.242}{y} + 7.25\right) \quad (4)$$

Let the expression $\left(\frac{0.242}{y} + 7.25\right) = \frac{1}{z}$

where z = elasticity form factor.

Then, with mating gears of different materials

$$d_t = P\left(\frac{1}{E_1 z_1} + \frac{1}{E_2 z_2}\right) \quad (5)$$

Abstract of Progress Report No. 4 of the Special Research Committee on Strength of Gear Teeth, American Society of Mechanical Engineers.

Although the tooth contact along the line of action will cease as soon as the tip of either tooth profile crosses it, the load will not be instantaneously transferred to the pair of teeth remaining in theoretical contact, because of deflection of the profiles. An exact solution of the distance D, in which this transfer of load is effected, is very complicated, but with several approximations, the result can be simplified. For instance, if we assume that the distance along the line of action from the pitch point to the end of theoretical action is three-quarters the circular pitch, then

$$D = \frac{R_1 R_2}{R_1 + R_2} \arccos \frac{0.75p - d_t}{0.75p} \quad (6)$$

Where, R_1 = pitch radius of pinion, in.

R_2 = pitch radius of gear, in.

p = circular pitch, in.

The difference in static deformation between a single pair of teeth in contact and two pair will always be slightly less than one-half the static deformation of a single pair but for simplicity it can be assumed equal, or

$$e = \frac{d_t}{2}$$

where e = difference in static deformation.

The additional load caused by acceleration is given by the basic equation

$$f_1 = Ma \quad (7)$$

where f_1 = load due to acceleration

M = effective masses of gears at pitch line

a = acceleration caused by deformation

Equation (7) can be reduced to more specific terms

$$f_1 = \frac{MeV^2\cos^2 a}{150D^2} \quad (8)$$

where, V = pitch-line velocity in ft. per min.

a = pressure angle.

When approximations are introduced, equation (8) becomes

$$f_1 = \frac{MeV^2}{MeV^2 + 150D^2 f} \quad (9)$$

where f = applied load, lb.

The effective mass M is equal to $\frac{M_1 M_2}{M_1 + M_2}$ where M_1 and M_2 are the effective masses at the pitch line of the pinion and gear, respectively.

The maximum load F equals the applied load plus the acceleration load. This acceleration load would be imposed principally upon the undeflected tooth profile as it came into action, so that with perfect gears the acceleration load due to deformation probably would not increase the load by an amount greater than the transmitted load. If the teeth should leave contact, they would come together again with impact, causing a much heavier load. However, with perfect gears and a constant applied load, such impact is impossible.

Some of the ideas that are in use today have been developed from suggestions given by the workmen. Yet, in some cases, little credit has been awarded. Lack of appreciation is the quickest way to dissatisfaction.

THE · FOREMAN'S · ROUND · TABLE

Should the Shop Govern Purchases?

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

"GOL darn that purchasing office, Al, I'm going to bust in there some day and tell them a thing or two."

"That's what you ought to do if you feel that way, Ed. It don't get you anywhere to pile up grouches by yourself. What's on your mind anyway?"

"Well, it looks like they've gone nuts on price. Seems as if every time we get things sailing nicely in the shop along comes some bug in the purchasing department who finds that he can save a quarter cent a pound by buying stock somewhere else. One day it is castings, another time machine bolts, and now it is that brass sheet we use for making those caps."

"Why not buy it at the cheapest place, Ed?"

"It's just this, Al. You know very well that steel isn't just steel, and that any brass won't do for all operations. We worked for months on that cap job. You see, it has to be drawn first, and then that fine thread has to be chased on the outside.

"Well, when we got a good drawing brass, the thread tore, and wouldn't pass inspection. Then when we got a hard brass the shell wrinkled in the first drawing operation. After we had experimented with the dies and chasing tool we had the Jones brass engineer down, and he has given us an alloy that just does the trick. It cost the brass company some money, too, in experimenting with us, and seems to me it's entitled to the business for a while."

"Well, why can't they have it, Ed?"

"That's just it. The purchasing department says it can buy rolled leaded brass half a cent cheaper at Smith's. That will save the company five hundred dollars this year. But the Smith brass is harder and won't form in the dies. It's gonna cost us a lot more than five hundred dollars in the shop to experiment again just to give the purchasing department a record of saving."

"Well, Ed, quit the grouch now, and have a session with the purchasing agent in the morning. I met him at the Lodge one night and he seems quite human. Maybe your case is just the right example to get more co-operation between purchasing department and the shop. Let me know how you come out."

Who should have the say on material purchases?
Is price the first consideration?
Should a seller charge for its technical service?

All foremen are urged to discuss these questions. Acceptable letters will be paid for. The discussion is not limited to foremen, of course

Discussion of Earlier Topics

Do We Buy Labor or Production?

IF YOU ask a workman, he will say he is paid for his effort, time, or care brought to his task. If you ask an employer, he will say he pays for production. The former wants to be paid for what he gives; the latter wants to pay only for what he gets. Both are wrong, in that their points of view are too exclusive of each other's, and because there is no equality between effort and product. The question may be compared to that of buying electric power; you would never agree to pay for the current according to the coal burned to produce it; nor on the basis of the actual work performed on your machine-tools. The big waste of power which occurs all the way along has to be taken into account. It is the same case with human work. The potential work existing in workmen is never entirely converted into production, so that neither their productive capacity, nor the quantity of articles turned out can be exclusively taken as a basis for remuneration. In the case of power supply, a meter is inserted at the point where the electric current leaves the equipment of the power company to pass on to the installations of the buyer, beyond which point each of them endeavors to reduce its own waste to a minimum.

The responsibility for work is on both employer and employee. Employers control work conditions, while employees govern their professional capacity. Thus, any waste of effort is to be attributed to employer if it results from a bad arrangement of the workshops, from the use of defective equipment, from an inefficient organization, or from lack of instructions regarding the job. On the other hand, it is up to the employee if it comes from his want of aptitude, from unobserved instructions, from neglect, or idleness.

—ROBERT A. CAUSSIN, *Commercial Eng., Belgium.*

TO SUPPOSE that a foreman's job is to get men to work for the lowest rate does not work out in practice. One case known to me is typical of many. Some years ago a leading firm of engineers that was well to the fore in the manufacture of electrical equipment appointed a new manager who held the views of Ed's friend. He introduced a low fixed rate of wages with a sort of bonus, discharging all those who did not reach the minimum output as fixed. Of course the worthwhile men all left, the duffers remaining and skimping the work to reach the manager's limit. Very soon trouble commenced and machinery came back as defective. Today this firm is a third rate concern.

It may be said that we buy both labor and production, but fads and fancies must be considered as in buying boots. The foreman must deal with each man individually, and should have a free hand to advance wages up to a limit, which may be fixed if thought necessary. If he uses care, allowing no leg-pulling or favoritism, the giving of an increase to a workman unasked for, may have a far-reaching effect for good, creating new life in the shop and much healthy rivalry.

—F. P. TERRY, *Ireland.*

Getting New Blood in the Shop

MACHINE shops should not turn to outside sources for foremanship material until inside possibilities have been exhausted. Oftentimes a stranger is taken on who somehow cannot get along with the employees. There are occasions where some aspiring and worthy man from the force, possessing experience and foresight, should have been chosen, and when this type of man must take orders from an utter newcomer, knowing less of the shop than the employee of long experience does, it is small wonder that harmony is lacking. Bear in mind, your insider represents a peculiar experience, an experience closely concerned with the shop, and this is well to consider when a foremanship is in contemplation. Further, your insider knows the rest of the force; he knows their individual temperaments, inclinations, failings, and abilities. When the stranger, even though highly touted, comes along, there is entailed an experiment not necessary in the case of the knowing insider. There is another phase which it is folly to blanket. The real worthwhile man from the force, keen for growth, and eager to get ahead in your shop, is not particularly encouraged when he sees some newcomer step in ahead. The man eager for promotion usually is loyal and does something to warrant recognition. He likes to see that recognition develop into something tangible, and there is no better incentive to stimulate such ambition than is afforded by the foremanship given to the deserving individual from the force. When other ambitious men from the shop observe that there is little chance for a foremanship, there is not the inducement to stick to that shop, and they will leave at the first opportunity.

—FRANK V. FAULHABER.

IT IS conceivable that a combination of circumstances may get a shop into such a state that it is imperative to jolt it out, and getting a new foreman is one way to do it. Then, too, a foreman may go stale by not keeping abreast of the times. Again, the nature of the products manufactured may undergo a change, and the man who was satisfactory on the original line may not have had the experience or the ambition to adapt himself to the new products.

The new foreman can best get co-operation by consulting the management as to the best man available in

THE · NEXT · TOPIC

Should the Foreman Get a Bonus?

QUESTIONS

Does the bonus for foremen increase production?

What objections are there to it?

Will a straight salary secure the same interest?

the ranks, going to him and frankly explaining the situation, asking him to help reorganize the shop as his assistant. In general, the situation calls for the utmost frankness on all sides. If he notices a man or a group of men acting surly, the quicker he calls them and invites them to state their grievance in a friendly manner, the sooner will the shop return to normal activity.

—HARRY A. PLANT.

Is the Repetitive Operation to be Avoided?

REPETITIVE operations cannot always be avoided and in some cases do no harm to the men performing them. To some men the repetitive operation has the effect of deadening their efforts and power of thinking and makes them lazy. For this reason a change should be given them, if only for a couple of hours a day.

Many men get proficient on one job or one machine and when changed make mistakes. Men of this class are generally content to do one operation.

When a vacancy occurs in our shop the job is bulletined and the men bid for it. The senior man gets the job if he is qualified for it, and in many cases we are willing to spend some time in teaching him if he has shown promise of being a good man. This affords an opportunity for the men to shift around to their own advantage, and it gives the employer a gang of men who can be placed almost anywhere and do good work. Many of the older men, who have been on certain jobs for years, never bid in any of the new jobs, preferring to stay where they are doing the same work day after day for years. This to my mind, shows that repetitive operation is not as bad as some people picture it.

—WALTER E. SHANNON.

I FIND on my own staff men who are happy to be assigned work that will run continuously, and to get the best out of them it is not necessary to change them around. On the other hand, I have men who are more productive when shifted from job to job. My opinion is that both are necessary to make good teamwork. The best team is built up by the foreman who studies the capabilities and dispositions of his men.

—C. L. HENRY, *England.*

Will Standard T-Slots Help Production?

THE standardization of T-slots should be universal. That is, it should include all machines that have T-slots. This includes drill press tables and lathe face plates, as well as the tables of the miller and planer. It solves the question of carrying a great supply of miscellaneous T-head bolts that you find scattered about every machine. It means the shop can carry a smaller number of bolts in stock to be available for all machines. Then, a standard width of tongue will be possible, and will cut down the number of vises and fixtures.

—WM. B. BARNETSON, *Canada.*

NOT only will standard T-slots help in transferring fixtures from machine to machine, but they will really make it possible without risking the loss of your temper for the day. I suppose the next generation of foremen, reading the history of machine-tool standardization and its inception with standard T-slots, will look upon the present situation with the same degree of amazement as we look on the days when each nail was hand wrought by the blacksmith.

You can rest assured that standard T-slots would influence me in buying a new machine. Not only for the time, labor and money they would save me, but also because I believe we owe practical encouragement to the standardization movement of which I believe standard T-slots are only a beginning. The standardization program may have been a little slow getting under way in the machine tool industry, but we can surely make knots from now on, if we'll all get behind the movement and help it along by specifying standards on all our new purchase requisitions.

—JOHN W. GARDINER.

THE standardization of T-slots will be greatly appreciated by all users of machine tools, for we all have had our troubles in transferring fixtures from one tool to another. In checking up the dimensions of T-slots recently on a group of machine tools, it was found that not only did the slots vary greatly in their dimensions, but also that there was no uniformity in the spacing of the slots, and it occurred to me that it would be a great advantage, along with the standard T-slots, to standardize also on the spacing of the slots. I suggest that they be made in even inches as follows: 2, 3, 4, 6, 8, 9, and 12-in. centers, to accommodate the various sizes of tables.

—MARTIN H. BALL.

Who Should Go to the Storeroom?

THE most economical system that I have seen in practice to save the time of high priced men is for the foreman to have one or more boys to run errands. These messenger boys, whose headquarters is the foreman's office, take orders from the foreman to the men, and generally wait upon the foreman in every way. They soon become very efficient at finding their way about the works. They learn quickly the names of articles and where to get them, and soon become a real help to the foreman, and if a boy is employed to help say 2 or 3 assemblers, he will save many times his wages.

—H. MAPLETHORPE, *England.*

CARRIGAN'S provision of requisition stations is good for the larger shops, this being similar to the interdepartmental mail systems which have been in operation for many years in some works. But "schedule" has its disadvantages, because a requisition collected on the outward journey of one round will not reach the store until the end of the round, and will then have to take its turn with the rest of that batch for attention.

What a pity that young Frank did not get his ideas of the Pacific Coast railroad shop runner system mixed up with the cash-desk system of any large store. Look at the saving if the man enclosed his memo and tool check in the carrier of a pneumatic conveyor that delivers them in a few seconds at the storeroom. The parts could be on the way to the man by the next outward journey of the runner. If another check then accompanied each tool, the return of this by the same means would indicate that the tool was ready for return to the store.

—ALBERT F. GUYLER, *England.*

Ideas from Practical Men

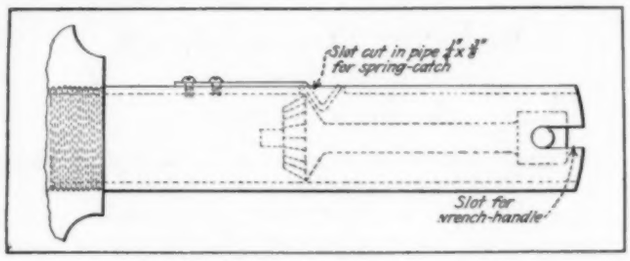
The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

A Place to Put the Chuck Wrench

By O. Holm

One of the inconveniences of working with a portable electric drill is that the chuck wrench may become seperated from the drill proper at the most inopportune moment. If this occurs lost time and curtailment of production naturally result.

If one's drill happens to be of the type having handles made of pipe, the possibility of mislaying the wrench can



Handle adapted to receive wrench

be obviated by the simple expedient illustrated in the sketch.

One of the handles is slotted in the side and end, two holes are drilled and tapped, and a spring-steel latch, fashioned as shown, is attached.

A Continuous Milling Fixture for Drill Tangs

By Jack Williams

The device shown in the accompanying illlustration is employed by the Morse Twist Drill & Machine Co. to mill the tangs upon the ends of small sized taper-shank drills made by the company, in whose shops it was designed and constructed.

It is mounted upon the table of a milling machine of standard type and driven through suitable gearing from the feed shaft of that machine. The work-holding member consists of a disk that is mounted upon the end of the work-spindle, which spindle is slowly and continuously rotated while the work is in progress.

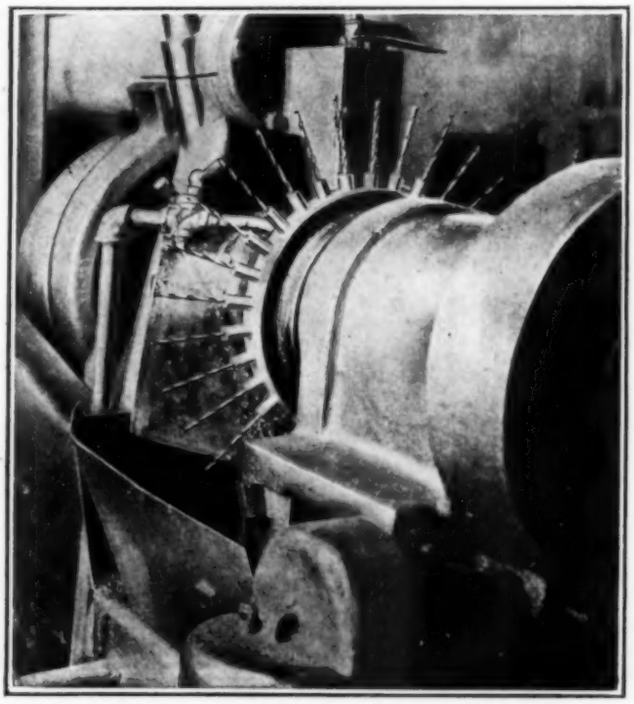
The face of the disk is bored, or recessed, to leave a heavy rim somewhat less in thickness, measured radially, than the length of the taper shanks upon which the tangs are to be milled. Radially disposed holes in this rim are bored and taper-reamed to fit the shanks of the drills, and when these shanks are driven into the holes they project into the recess far enough to expose a length somewhat greater than the depth of the tang.

In the spindle of the milling machine, which is, of course, parallel with the work-spindle of the device but in a different plane, is an arbor upon which is secured a pair of straddle mills, the individual cutters of the pair being spaced apart by an amount equal to the thickness of the tang to be milled. The arbor extends into the recess of the annular work-holding member to bring the cutters into a plane with the inwardly projecting ends of the drill-shanks.

Once adjusted for the cut upon a given size of tang no further relative movement takes place. The cutters revolve at a rate calculated to give them a proper peripheral speed and the work holder rotates slowly in the opposite direction to feed the work to the cutters.

The device runs continuously and the operator's duty is to set the drills into the radial holes as the latter present themselves in convenient loading position. A tap with a lead mallet upon the point of each drill seats the shank in the taper hole with sufficient firmness to prevent it from being dislodged by the pressure brought to bear upon it by the cutters.

As each shank passes the revolving cutters, during which passage the tang is milled by them, it strikes a stationary cam the eccentrically disposed surface of which pushes the shank gently out of the hole. Thus no drills remain in the holder below the position occupied by the lowest one visible in the illustration, and the



Continuous milling of drill tangs

holes in the opposite side of the holder are free to receive unmilled shanks at the convenience of the operator.

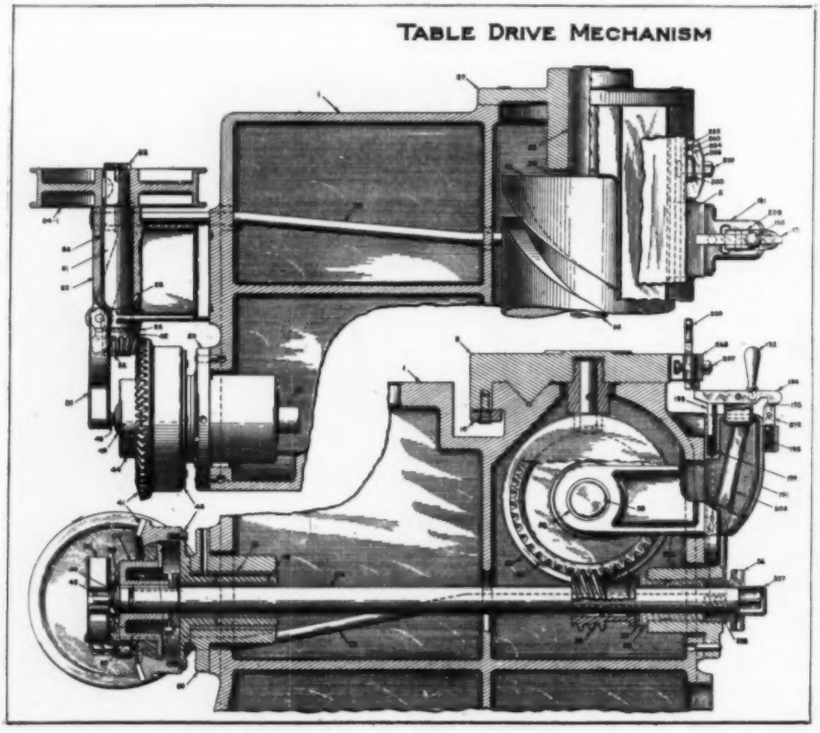
The proportions of the holder and work (the diameter of the rim, the size of the shank, and the number of radial holes in the rim) are so calculated that there is practically no space between the adjacent ends of the shanks projecting within the recess, and the cutters are thus kept at work in solid metal all of the time. As the rates of rotation are under complete control, and the operator has no other duty than to see that the holes in the holder are kept filled with drills, the cutters may be driven to the maximum limit of their capacity with no lost time between cuts.

Illustrating Machines by Line Drawings

By C. G. Williams

The writer has long felt that a too general use of photographs is tearing down one of the finest of mechanical arts, that of making line drawings and of making them talk the language for which they were made. Because of the idea that photography alone would suffice to sell machines, artistic line drawing has become almost a thing of the past, and it is seldom that one can find a man who can do this type of work.

It was with pleasure that I came across some of this work as done by one of the old-time true artists, an example of which is shown in the accompanying illustration. Would not any catalog be better with one or more of this type of drawing to illustrate the action of the inside of the machine? I believe that the artistic line drawing should be used to supplement the photograph. It seems that this class of drawing must come back, for with the increase in complicated mechanisms in special machinery, the line drawing is the only way to give the prospective customer the knowledge he wants.

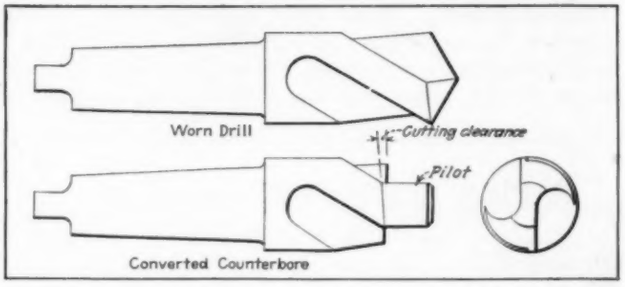


Example of artistic line drawing

A Use for Short Drills

By H. Lameck

A broken drill or one ground until it is too short for general use, can be made into a counterbore, as shown by the illustration. Such a counterbore will give more



Counterbore made from a twist drill

satisfaction than will the ordinary ones, since it will cut so freely that it can be used at about as high a speed and as coarse a feed as in drilling.

Reducing Drafting-Room Checking Cost

By John F. Hardecker

All engineering or drafting time is charged as overhead in a modern manufacturing organization. Checking time therefore becomes a sort of "super overhead" or an overhead on an overhead. In this day of close margin of selling price over production cost, every effort is made to reduce the overhead from any source. Therefore, what is a more logical point of attack than this overhead on an overhead?

In a large aeronautical plant the following procedure is used with signal success: the design is basically carried out under the direction of a project engineer. He issues his general instructions for the design to a drafting-room squad leader who, in turn, supervises the work of the various draftsmen assigned to the particular project. Originally, all drawings were checked rigidly for all features, so that checking time averaged about 35 per cent of drafting time. The first step toward improvement was to keep a record charged against each individual, of the errors occurring in his work, as reported by the planning office or shop. The draftsman was charged with 60 per cent of the responsibility and the checker with 40 per cent, in terms of the time necessary to revise the drawing, with a minimum charge of one hour. This not only served as a good basis for rating the draftsmen's ability, but it disclosed that certain men made practically no errors of any consequence. These men were placed in the preferred class, so that, in many instances, their work was subject only to a general inspection and the

detail check was completely omitted, or because of the confidence the man had previously inspired by his work, the checker merely gave it a general cursory check. The use of this system during a considerable period of time has disclosed no appreciable increase of errors, and has resulted in a reduction of the average checking time from 35 to 15 per cent of the drafting time.

Drilling With the Work and Jig Submerged

By Arthur A. Merry

The jig used in drilling the piece shown in Fig. 1 became so hot that the operator could not hold it. We hit upon the idea of making a pan and drilling the work under water. This method gave us an increased production of 50 per cent over the oil-can method, and the same idea has since been used on other jobs with the same degree of success.

In making the tanks we bend a piece of $\frac{3}{16}$ in. stock into the required shape and weld the joint. We then weld this to a piece of $\frac{1}{8}$-in. stock, which forms the

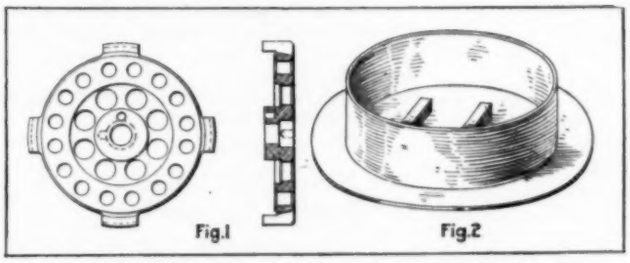


Fig. 1—The piece drilled. Fig. 2—The welded pan

bottom, allowing enough stock for clamping to project around the edge, as shown in Fig. 2. The locating blocks for holding the jig out of the chips are welded in place and machined afterwards.

The work pieces shown are drop forged from tough, hard steel that would burn the point off the drill in spite of the amount of coolant that would be supplied by an oil can.

A Method of Checking Threads —Discussion

By Charles Kugler

Replying to the article by Arthur Silvester, under the title given above and published on page 468, Vol. 66, of the *American Machinist*, I desire to say that no claim is made that the method given by me is the best method of checking a chaser, but I think it is the quickest and simplest way that I have seen.

Mr. Silvester asks how I calculate the amount of error, if any. I do not know of any way to find the error, and do not have enough chasers to check to be very much concerned about the amount of error. All that I checked were good enough for the work at hand, since they were bought from reliable small-tool manufacturers.

I think Mr. Silvester is correct in general in his views on the wire system of measuring threads, and I believe no one would use this system if a thread micrometer were available.

Practical Shop Problems

Questions of a Practical Nature will be answered in this column

Origin of the Standard Screw Threads

Q. What is the difference between the National screw thread and the United States standard thread? When were standards first adopted for screw threads?

A. The system of screw threads known as the United States' Standard automatically passed out with the adoption in 1924 of the National standards by the American Engineering Standards Committee. The national coarse thread series corresponds in diameter and pitch with the old United States' Standard, but provision has now been made for tolerances and clearances. In addition to this series there is the fine thread series, and also the extra-fine thread series.

The English Whitworth system antedates the American standards, as it was proposed as early as 1841 by Sir Joseph Whitworth. The beginning of the American standard threads dated from 1864, when William Sellers proposed the old United States Standard thread, which was later recommended by the Franklin Institute. This thread became widely known as the Sellers' thread, and also as the Franklin Institute thread.

Case-Hardening Irregularly Shaped Parts

Q. We have been experiencing very unsatisfactory results in case-hardening some irregularly shaped soft-steel parts which we handle in large lots. Our chief trouble is from warping, although we have had some difficulty with cracking. We are pack-hardening and quenching in water. What should we look to as the likely cause of the warping? We are not able to change the general design of the parts.

A. In making recommendations we can only point out the most likely causes of the trouble, as there are numerous factors to consider, and a close study of a particular problem of this kind can only be made on the job.

Assuming that you are employing a carbonizing compound of good quality, and that it is renewed frequently enough, so as to avoid unequal carbonizing from that source, you should investigate the method of packing to make certain that all parts of the articles are enabled to absorb carbon to the same extent. The pieces should be evenly arranged to get an even distribution of compound around them, and not allowed to touch each other or the sides of the box. The heating temperature is important, the best results being obtained at a temperature of about 1,650 deg. F. Warping and cracking are very likely to occur in quenching from higher heats. While higher temperatures will quicken the time of carbonization, this advantage is more than offset by the difficulty of quenching, and in the coarser grain.

The shape of the parts will influence the method of quenching. You will find by a little experimentation one best position for plunging in the bath so as to get the minimum amount of warpage. The workman should not be left free to quench the parts in any fashion that they happen to come. Very good results have sometimes been obtained by dumping the entire box into the bath so that the hot pieces are not exposed at all to the air.

Technical Abstracts

German Machinery Exports

During the year 1926 German exports of metal-working machines increased steadily, while the imports declined in like proportion. The countries that before the war were the best German markets for machine tools are resuming their old positions in relation to Germany. The total exports of machinery during 1926 amounted to 716,744,000 marks, as compared to 656,308,000 marks in 1925. The greatest gains in exports have been with the United States, Great Britain, Italy, Russia, and Spain, and these countries take a large proportion of the German metal-working machines exported. The total number of machines exported in 1926 was 104,192, as compared with a total of 82,817 during the previous year.—*Die Werkzeugmaschine*, Berlin, April 15.

Selection of Personnel

On account of the industrial interest in personality there are a great many charlatans at the present time who profess to be able to read personality at a glance. They are preying on manufacturers and employment managers generally. Many of these fakirs advertise even in some better magazines. Chief among them are the head hunters. There is at least one big institute in New York that takes annually out of industry a fortune for selecting men on the basis of head measurement.

Then, we have a specially gifted bunch of fakirs who claim to read the personality and character of individuals from photographs. These men refuse to submit their operations to any scientific test, but they go on selling their service. There is hardly a city of 100,000 population that hasn't a crew of these fellows coming in to "assist" industry.

There is another group of fakirs advertising who agree to pick out your man on the basis of hair color, texture of the skin, or color of the skin. To dismiss such claims we need only mention that the big experimental laboratories cannot find that there is the slightest evidence to any of these claims. The phrenologist is another rapid personality reader. The bumps on your head, so he says, reveal everything to him. By charting the bumps he charts the individual's abilities. The fact is that the brain, as a rule, is smooth and almost floating in a liquid, and phrenology passed out of the interest of scientific men decades ago.

Then we have the graphologists who tell us by our handwriting what our potentialities and characters are. In handwriting, of course, we have a definite product of activity, and hence it may give us some kind of cue as to the person's character, but psychologists have been studying this matter and find the correlations only very sketchy. These graphologists cannot even determine easily whether the writing is that of a man or of a woman.

In regard to special tests, the psycologists themselves admit that they are not adequate as a complete basis for the selection of personnel. It is possible to devise performance tests for carpentry or metal working, but there are many vocations in which no form of testing is applicable. The first impressions are important, but it is an old wives' tale that an applicant should be able to look squarely into the boring eye of the employment manager. There is nothing like daily observations over a period of months for measuring the capabilities of personnel.—Dr. John B. Watson, *Printers' Ink*, April 21.

Typical Grinding Operations in British Railroad Shops

The grinding of piston rods is another prevailing source of economy in (British) railroad shops, especially as the modern piston rod assembly is a far more costly unit than was heretofore the case. Piston rods and pistons are now being made integral and the rod is bored in conformity with the general desire to reduce the weight of reciprocating parts. The whole unit is heat-treated and it is, therefore, necessary to grind it. Being bored, the rod and piston assembly represent a higher investment than was previously the case, and, furthermore, the minimum permissible diameter in increased, thereby emphasizing the necessity for the utmost economy in the use of the wearing skin. It has been definitely proven that rods which are ground remain steam-tight over a longer period than those that are finished by other methods.—R. E. W. Harrison, *Abrasive Industry*, May.

How Labor Locates Industries

Labor supply and quality not only constitute major factors in the selection or retention of a site for an industrial plant, but often are of transcendent importance in manufacturing success. In some industries labor cost far overshadows the other charges; in others it is relatively small. The dominant factor which has moved much of the textile industry from New England to the South has not been the nearness to the raw material as much as the excellent southern labor.

Major elements to be investigated in connection with the labor situation in any industrial district are as follows: Quantity, kind, wage levels, working hours, efficiency, housing, civic conditions, recreation, labor unions, and labor laws. In general, labor supply is better near a locality having a diversification of industries. However, if a district has specialized in one industry, it may be able to manufacture more cheaply than under diversified conditions, because it has highly skilled labor, and its plants tend to co-operate in improving methods.

One way of measuring labor efficiency is by the turnover in the district. One city shows a 60 per cent turnover, while others show up to 240 per cent. The poorer showings may indicate unfavorable housing conditions, or an illiberal labor policy in the district. Transportation conditions for labor in the district are also more important than may appear on the surface. The conditions concerning industrial housing can easily be investigated by any responsible industrial realtor. The civic conditions to be studied include schools, churches, hospitals, water supplies, sewage disposal, and the community experience in regard to diseases. The public spirit towards wage earners is also important. The local labor laws should be studied from both angles of hindrance and beneficial results.—Harrison S. Colburn, *Manufacturing Industries*, April.

The Kitson-Still Internal-Combustion Locomotive

There was recently built in England a passenger locomotive operating on the Still system using a combination cylinder with steam pressure on one side of the piston and pressure furnished through the internal combustion of oil on the other. The locomotive is designed to exert a tractive effort of 24,500 lb. from starting to a speed of 6 m.p.h. and dropping to 7,000 lb. at 45 mi. per hour.

A four-stroke cycle is employed on the internal combustion side of the engine, and eight cylinders are employed in all, disposed in a horizontal position underneath the boiler, which is oil-fired. The exhaust gases from the oil engine are also used to heat the water in the boiler. Through crossheads the pistons drive a crankshaft which is geared through a spring coupling to a jackshaft, which, in turn, drives three wheels on each side through cranks and connecting rods. No flywheel is used in the system, but the cranks are balanced with lobes. The gear system is centralized so as to be free from trouble due to weavage of the frame when passing over rough tracks.

In developing the type of cylinder head to be used in this locomotive, considerable experimental work was done, particularly in connection with the design of the combustion chamber and the various passages leading to and from it. In the final design the cylinder consumed 0.36 lb. of oil per hp.-hour and produced a mean-effective pressure of 80 lb. per sq.in. with 10 per cent of free oxygen in the exhaust. Detonation was reduced to an unobjectionable quantity. —Lt. Col. E. Kitson Clark, *Engineering*, April 15.

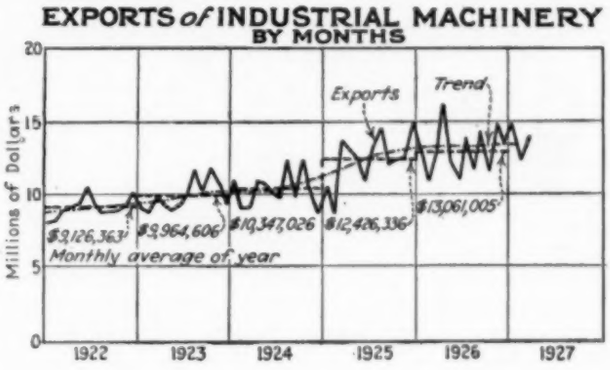
Activity in the Metal Working Industries

Operations Increase During April

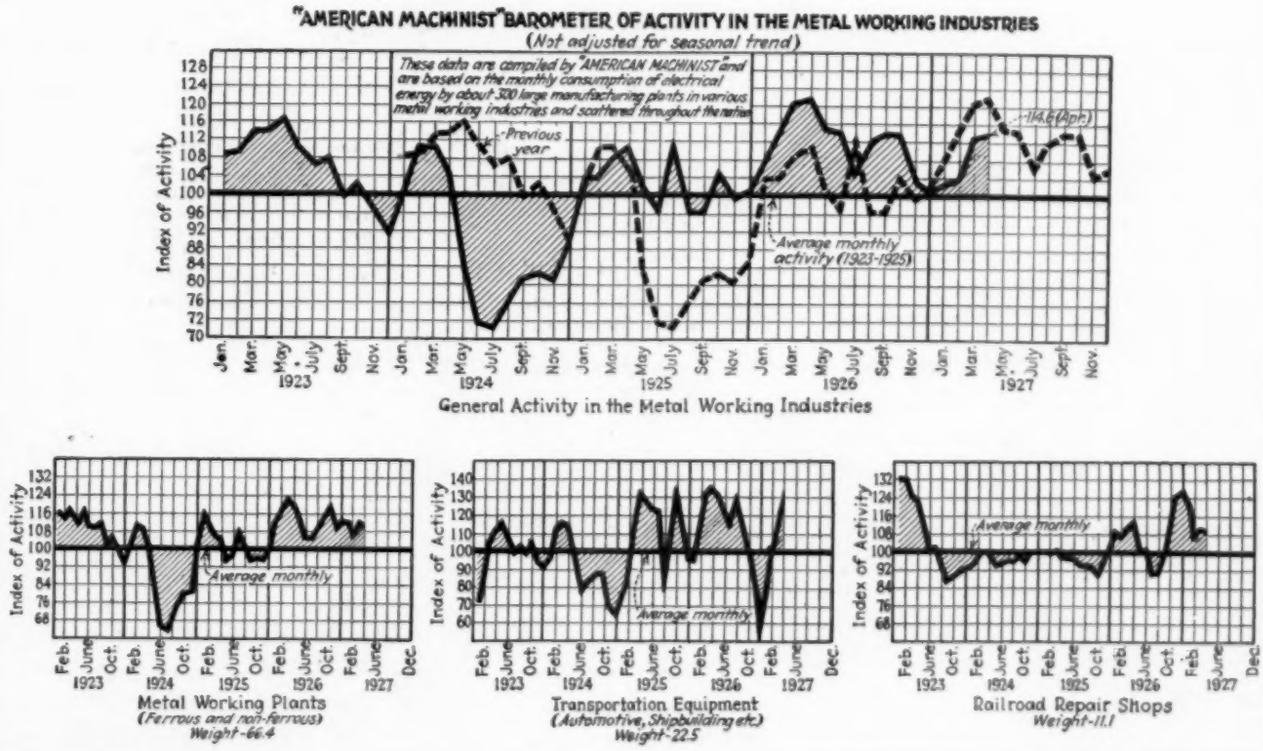
A slight increased rate of productive activity was evident in the metal-working plants of the nation during the month of April. The actual production of these plants during the month was only about 1 per cent over March, but corrections for the number of working days in the two months indicate that the rate of production during April was about 6 per cent higher than that recorded during March.

The metal-working plants as a group have been increasing their productive activity continually since the opening of the year, the activity during April being about 11 per cent over that recorded during January. The activities during this period, however, have been lower than those recorded for the same period a year ago, April operations being about 6 per cent lower than April of last year. The production operations of the metal-working plants appear to be following approximately the same trends as last year, but on a lower plane. Such is the picture of operations in these plants indicated by their monthly consumption of electrical energy as tabulated by the *Electrical World*.

On account of the high rate of production during the first quarter of the year it is likely that the activity during the summer months will be slightly under that which would have normally been expected at that season of the year. But there is nothing to indicate that activities in the metal-working plants during the fall months will not increase over the summer months in a normal manner. Exports of industrial machinery, according to Department of Commerce figures, still continue on a high level.



Business and industry are today operating above the estimated normal, but there is nothing in view to indicate that they will not continue in this general way for some time to come. That general production will overtop the records of 1926 seems unlikely in view of the improbability of a further expansion in the building and automobile industries. On the other hand, that they will fall materially under 1926 seems equally unlikely as long as credit supplies continue in the present abundance.


"AMERICAN MACHINIST" BAROMETER OF ACTIVITY IN THE METAL WORKING INDUSTRIES
(Not adjusted for seasonal trend)
These data are compiled by "AMERICAN MACHINIST" and are based on the monthly consumption of electrical energy by about 300 large manufacturing plants in various metal working industries and scattered throughout the nation
Index of Activity
Previous year
114.6 (Apr.)
Average monthly activity (1923-1925)
1923
1924
1925
1926
1927
General Activity in the Metal Working Industries
Average monthly
Metal Working Plants
(Ferrous and non-ferrous)
Weight-66.4
Transportation Equipment
(Automotive, Shipbuilding etc.)
Weight-22.5
Railroad Repair Shops
Weight-11.1

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American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

Established 1877

Trade Barriers

ON AT least one point the delegates at the Geneva Economic Conference seem to be agreed—the necessity of removing artificial trade barriers. Most American business men have little conception of the extent to which European business is hampered by import and export tariffs, anti-dumping clauses and the like. The free flow of commerce across state boundaries in the United States is absolutely different from the stagnation that often exists in international trade beween adjacent European countries, and is one of the big reasons why prosperity persists on the western side of the Atlantic.

Conditions would not be so difficult if the barriers remained fixed in height, but their rapid upward and downward fluctuations make long-term contracts practically impossible. The American system of a stated tenure of office for the party in power has certain recognized drawbacks but at least it insures the business man against any violent changes in tariffs until the next election. He may not like the restrictions under which he must do business, but he knows what they are and how long they are likely to continue and can therefore take steps to meet them with some assurance that he will not have to change all his plans overnight. In most European countries, on the contrary, although the fall of the government may mean political salvation it is quite as likely to mean commercial chaos.

General recognition of the interdependence of nations stressed by the delegates is the hope of the future. If it comes the leveling of barriers may well follow, with better times for Europe.

Reliability of Air Travel

SPECTACULAR events naturally attract the attention of the average citizen. Preparations for the transatlantic flight awoke great interest because of its never having been accomplished under the conditions imposed. And accidents that occur under these special and unusual conditions are unfortunately taken to mean that aviation is still a very dangerous mode of travel. A few figures from the Air Mail tend to change one's opinion on the subject.

The transcontinental airway is 2,669 miles long, of which 2,045 miles have been equipped for night flying. The way in which schedules have been maintained is remarkable. The service during 1926 totaled 93.58 per cent on schedule, with the day service in July reaching 99.57 per cent and the night schedule for the month a full 100 per cent. One pilot, Shirley J. Short, now regularly on the Cleveland-Chicago leg of the night service, flew 2,169 hours over a period of nearly 3½ years without mishap of any kind.

Such a record should do much to relieve the uneasiness caused by occasional accidents that are usually due to preventable causes.

A Challenge to Equipment Builders

A USER of machine tools and other production equipment has advertised that he will buy any machine or process that will pay for itself in two years. The advertisement is remarkable as an example of the way in which the leaven of equipment modernization is working through the industrial mass, and for the length of time given the new equipment to pay for itself.

Two years, of course, is not a very long time to allow before one gets his capital back from an investment. Fifty per cent per annum is a return worth any man's consideration. But it is twice as long as the period allowed by many manufacturers and must therefore be considered as relatively liberal.

The advertisement is a challenge to equipment builders to produce the goods, and at the same time a warning to the advertiser's competitors that they must look to their equipment if they are to meet his production costs.

Refusing to Spend Money Is Not Thrift

MAKESHIFT machining devices are very frequently a snare and a delusion. While they often reflect credit on the ingenuity of the designer they as frequently indicate that his managerial ability is considerably below par. Except on emergencies where a job has to be done in a hurry and there is no machine available, they are seldom profitable. They are, on the other hand, frequently responsible for the decline of a business, if not for actual failures.

Makeshifts and a false notion of thrift usually go hand in hand. The type of mind that considers all money not spent as being saved, is frequently found at the helm of businesses whose real assets are dwindling. Managers of this type allow the amount of money that must be spent to acquire a new machine to blind them to the savings to be secured by its use.

Successful managers know that it is necessary to spend money in order to secure the advantages of savings due to new equipment. Makeshifts with old machines do not mean thrift, but extravagance.

Shop Equipment News

Potter & Johnston "Power-Flex" Model 5-D Automatic Chucking and Turning Machine

THE Potter & Johnston Machine Co., Pawtucket, R. I., has added to its line of automatic chucking and turning machines the model shown in the accompanying illustrations, to which the title of "Power-Flex" has been given. A front view is presented in Fig. 1, showing the control levers and automatic timing drum, while in Fig. 2 the location of the feed gear box, the cross-slide cam-drum and other features may be observed.

The machine is of unit construction, and all major parts are assembled separately and bolted to the base, so that each unit is readily accessible. The base is of heavy box-construction and sets in a pan which surrounds the machine and serves as a receptacle and reservoir for the oil or cooling compound used upon the tools. The ways, or shears, upon which the turret-slide moves are separate pieces of steel, located by longitudinal tongues fitting into corresponding grooves in the bed and permanently secured to the latter by large tapered-head drawbolts. The steel ways are hardened and, after being attached to the bed, are ground in place.

The main spindle is made from a forging of high-carbon steel. It runs upon standard tapered-roller bearings, front and rear, which are 10 in. and 8¼ in. in diameter, respectively, and spaced 22½ in. between centers. A hole 2⅝ in. in diameter extends clear through the spindle. The front end is adapted to receive a 16-in. three-jawed chuck to hold the work. Scroll, lever-operated or pneumatic chucks may be supplied. All chucks are fitted with means to locate pilot bushings to guide the tools.

The drive is to a constant-speed pulley, running at 1,200 r.p.m., from an electric motor of 10 or 15 hp. according to the nature and power requirements of the work. Multiple V-belts provide the transmission when the motor is mounted above the headstock as here shown. A flat-faced pulley may be substituted for the grooved pulley in case it is desired to omit the motor and drive the machine from an overhead lineshaft. A double-disk friction clutch engages the pulley with the drive shaft, and is arranged so that a reverse movement of the starting lever applies a brake to stop the machine quickly.

Transmission of power through the head from the high-speed first shaft to the work spindle is by means of helical stub-tooth gearing, made of chrome-nickel steel and heat-treated. The gear chamber is closed and is partly filled with oil so that all gears, bearings and clutches within the chamber are amply lubricated by the splash. All gear shafts are of alloy steel, heat-treated, and run upon roller bearings of the same type as those of the main spindle. The clutches within the gear chamber are automatically operated by the cycle mechanism to change the rotative speed of the main spindle in accordance with the diameter of that portion of the work upon which the cutting tools are at the moment engaged.

Twenty speeds, ranging in five groups of four speeds each from 16 to 304 r.p.m., are provided for the spindle. The four changes in each group are effected automatically. Changes from one group of speeds to another is made by means of change, or pick-off, gears located in an easily accessible compartment at the end of the headstock unit; the desired group is selected when the set-up is made in accordance with the size of the work and the nature of its material.

All feeds are actuated through the gear-box *A*, Fig. 2, located on the rear of the base. Power is transmitted to this box by means of a silent chain from the main spindle so that the rate of feed is always in proper ratio to the work speed. Twenty-four feeds, arranged in geometric progression from 0.007 to 0.165 in. per rev. of the main spindle, are provided. These feeds are arranged in groups of three—coarse, medium and fine—for each group of spindle speeds and are engaged automatically as the respective stages of the work are reached. Selective changes, to be made in accordance with the nature of the work when setting the machine for a given job, are effected by means of three pairs of pick-off gears on the outside of the feed box.

The cross-slide is actuated by a drum cam located in the chamber *B*, Fig. 2, directly under the slide but outside of the base. Interchangeable cams of various contours are provided to adapt the movements of the slide to different classes of work,

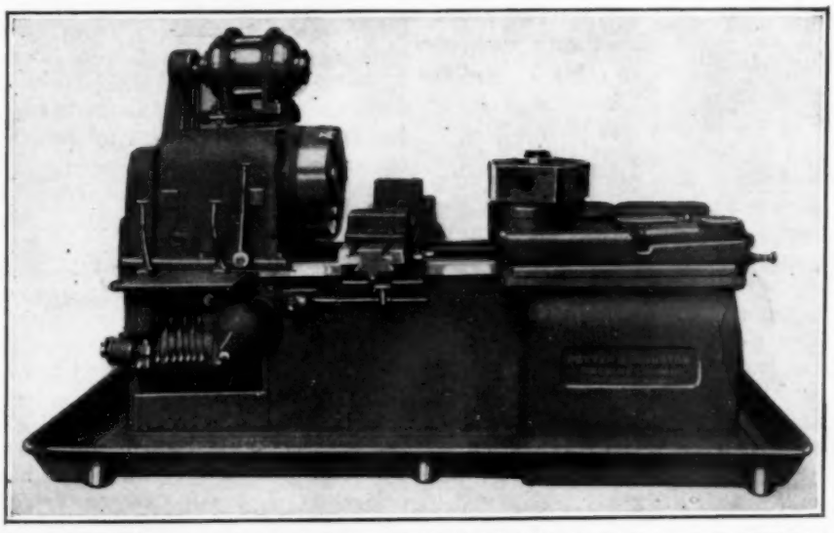


Fig. 1—Potter & Johnston "Power-Flex" Model 5-D Automatic Chucking and Turning Machine

Shop Equipment News

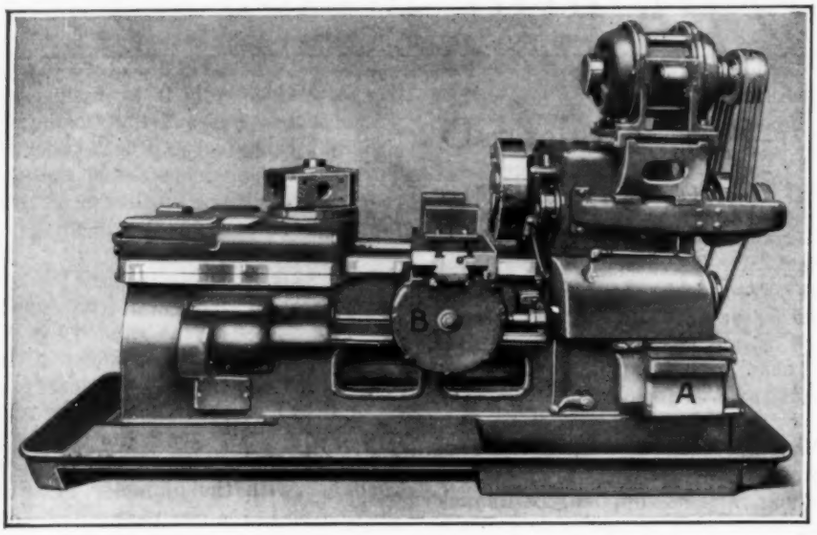


Fig. 2—Rear view of the machine, showing gear feed box

and may be exchanged by removing the cover of the chamber and slipping the drum off its shaft and driving studs. The movements of the slide occur in conjunction with the operation of the tools upon two consecutive faces of the turret; but these two faces may be selected—as first and second, second and third, etc.—throughout the turret cycle. All of the cross-slide operating mechanism is inclosed and runs in oil. The drive is through a worm and wormwheel. The slide travels 5 in. either way from its central position and has a transverse adjustment for position of 10 in. The compartment of the base under the slide is open at the back to facilitate the removal of chips.

The turret slide is also actuated by a steel drum-cam mounted upon a shaft extending through the base of the machine. The bearing surfaces of the slide are composed of inserts of steel, hardened and ground. A tapered adjustable gib provides means to compensate for wear. The slide has a maximum longitudinal travel of 13 in. upon the ways, and its position relative to the work is subject to a variation of 8 in. The machine may be adapted to allow a travel of 16 instead of 13 in., if necessary.

The turret has five faces and is indexed by means of a horizontally-disposed Geneva movement carried on the underside of the slide. It is locked in its successive positions by a steel locking bolt of rectangular section sliding in a guideway of hardened steel and seating in an index plate of large diameter. The turret is clamped tightly upon its seat after each indexing movement by a cam-operated drawbolt. All parts of the indexing and turret locking mechanism that are subject to wear or strain are alloy steel.

The sequence of changes in the cycle movement is effected automatically by means of adjustable dogs upon the drum to be seen at the lower left in the front view of the machine, and is also under control of hand levers at all times. The several clutches are operated by power, thus eliminating all strain upon the dogs or levers, which serve only to indicate when the movements are to be made. Changes, either of speed, feed, or both, may be made while the tools are at work without shock or danger of injury to the mechanism.

The machine is furnished with a pump to deliver oil or cutting compound upon the work from above, and, when so ordered, through the turret and tool shanks directly to the cutting edges of the tools. All slow-moving bearings are oiled from a common reservoir.

The maximum swing of the machine over the shears is 25 in. and over the cross-slide 12 in. Maximum length of work that can be piloted is 6¼ in., and the feeding of the turret slide is 8 in. Holes in the turret faces are 2½ in. in diameter by 3½ in. deep. The net weight of the machine is 10,500 lb., and the floor space 110x48 inches.

Goodell-Pratt No. 1,005 Electric-Drill Stand

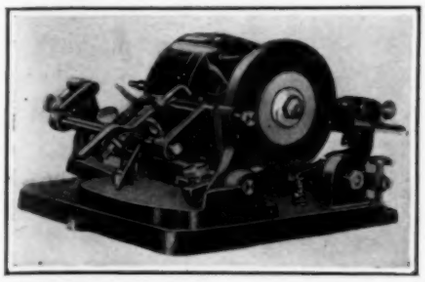
An electric-drill stand, designated as No. 1,005, has been added to the line of the Goodell-Pratt Co., Springfield, Mass. It is designed especially for its No. 1,042 ¼-in. heavy-duty drill. The drill slips into position in the stand easily and is locked by turning a thumbscrew. A spring compensates for the weight of the drill and the carriage is located inside of the vertical column. The lever feed can be set to any depth up to 3½ in. The extreme distance between chuck and table is 11¾ in. and it is possible to drill to the center of a 9-in. circle. The over-all height is 25 in. and the diameter of the upright column is 1½ in. The bench space required is 8½x12 in. The weight of the stand complete without the drill is 18¾ pounds.

Goodell-Pratt No. 1,005 Electric-Drill Stand

Wells Reamer and Tap Sharpener

The Wells Manufacturing Co., P.O. Box 613, Greenfield, Mass., has designed a small, motor-driven grinder for sharpening taps or reamers. The machine grinds the taps eccentrically according to a

Shop Equipment News



Wells Tap and Reamer Sharpener

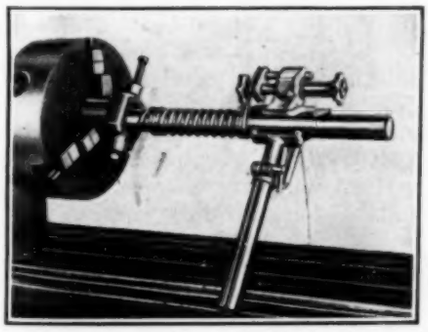
patented method developed by this company. The right to use the patent on taps goes with each machine. The indexing mechanism is such that all lands are ground alike.

When grinding reamers, the machine also grinds the relief eccentrically, and at the same time grinds the cut on a true curve.

The motor can be connected to any electric light socket, and hence can be located close to the work. The No. 1 machine takes taps up to ¾ in. and reamers from ½ to 1 inch.

"Superior" Spring-Winding Tool

An improved spring-winding tool has been placed on the market by the Superior Spring Winding Tool Co., Milwaukee, Wis. It will wind tempered spring-steel wire of any size from hair springs up to ¼-in. wire with a maximum diameter of 2 in. The pitch is regulated by an adjusting screw with graduations, and the tension of the wire is regulated by a friction plate and screw. The ends of compression springs can be closed. The tool can be used either in the lathe or in the vise, and it will make either right- or left-hand springs.

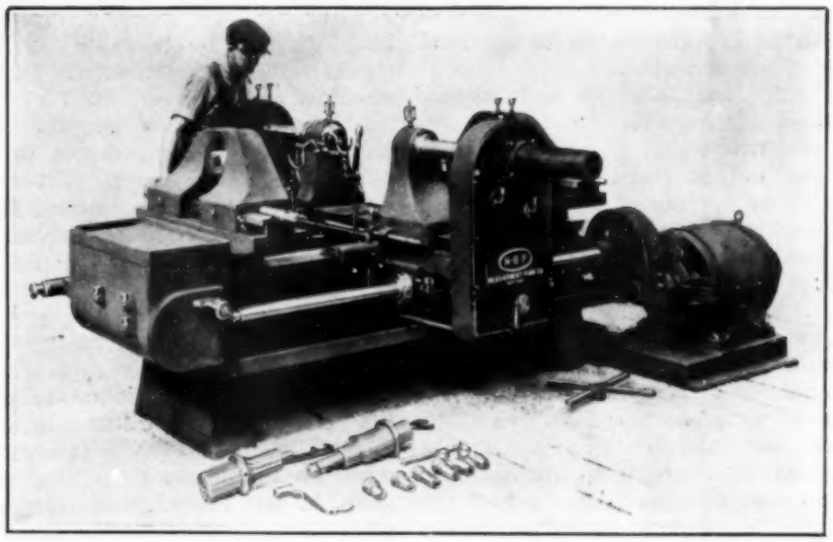


"Superior" Spring-Winding Tool

Malleable castings and hardened steel are used in the construction of this tool.

Niles No. 3 Cotter and Keyseat Miller

THE Niles Tool Works Co., Division of Niles-Bement-Pond Co., Hamilton, Ohio, has designed the No. 3 cotter and keyseat miller shown in the illustration for finishing cotter ways and keyseats in locomotive crossheads, piston rods and axles. The machine can also be adapted to many similar operations in railroad and in general industrial shops. The attainment of higher spindle speeds and improved collet construction are said to make it suitable also for milling keyseats in smaller work such as lift shafts, brake fulcrum shafts, valve stems, wrist pins, brake rigging pins and similar pieces found in railroad shops.



Niles No. 3 Cotter and Keyseat Miller

The machine has a capacity to mill splines up to 36 in. long by 2½ in. wide by 16 in. deep, and the chuck jaws will grasp work up to 12 in. in diameter.

The bed is provided with a trough and pan for collecting the cutting fluid which drains to a receptacle, from which it is delivered by a pump to the cutting tools. The carriage has reversible longitudinal traverse on the bed, and four different rates of feed are available, ranging approximately from 0.8 to 26 in. per min. The carriage longitudinal feed is obtained by a screw placed central with the bed and is automatically reversed by means of trips, at each end of the stroke, which can be varied to any desired length. Ball bearings are provided at each end of the screw to take the thrust.

The two spindle heads mounted on the carriage have adjustment transversely with automatic feed in an inward direction towards the axis of the work. The spindle heads may be used independently or in unison depending on whether single or opposite keyways are to be cut, or whether screw slots are to be milled. The spindles are 4 in. in diameter, and are arranged to receive No. 5 Morse taper sockets. The sockets are bored out for No. 4 Morse or No. 9 B & S split, taper collets having a $\frac{7}{16}$-in. hole for holding cotter drills.

Cross feed to the cutter spindles ranges from approximately 0.004 to 0.030 in. per rev. Feeding takes place at each end of the carriage stroke and an automatic stop is provided to prevent two opposite drills from contacting with one another when cutting through a slot.

The machine is regularly furnished with a pair of self-centering chuck jaws, fixed for height but adjustable longitudinally on the bed. The jaws are lined with hardened and ground steel plates and the chuck bodies are gibbed to their bases, thus providing for fine adjustment in all directions. For special work, a pair of centers, elevating chuck jaws, and a flat table can be furnished.

The machine may be driven by

Shop Equipment News

belt, by a variable-speed d.c. motor, or by a constant-speed a.c. motor in conjunction with a 4-speed gear box. A 5-hp. motor is required. The illustration shows the machine with variable-speed motor drive.

Victor Nut-Facing Machine

The rights to build and sell the Victor nut-facing machine, shown in the illustration, have been acquired by the Pawtucket Manufacturing Co., Pawtucket, R. I. Some changes in design have been made, particularly in regard to the facing head carriage or slide.

Nuts are faced on a hardened, threaded mandrel fitted with an equalizing collar, which insures that they will be faced true to thread. The cutters are of high-speed steel that is not machined except for grinding on the cutting edge to give it proper clearance.

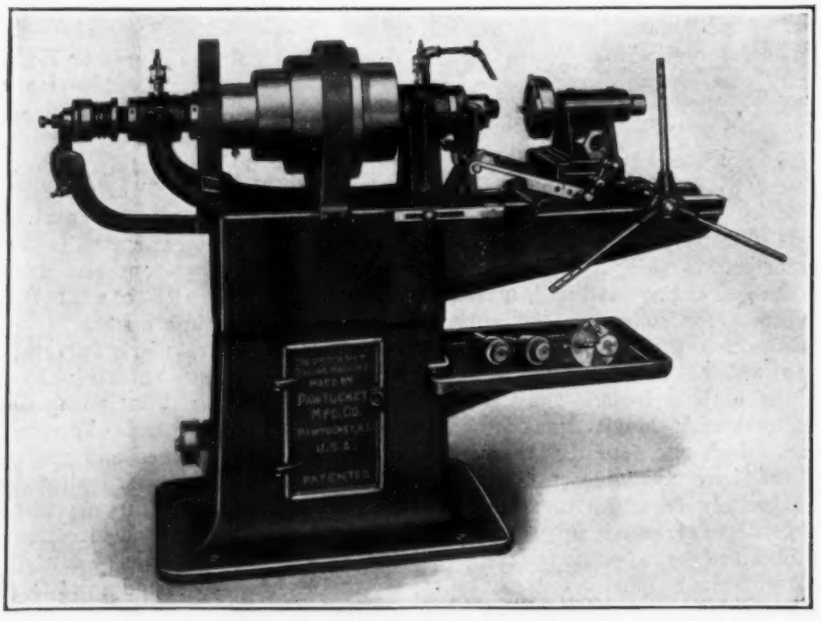
After the nut is faced, the operator reverses the facing-head carriage or slide and simultaneously, through linkage, a friction clutch mechanically reverses the spindle without reversing the driving belt. A yoke fitted with a pair of fingers then automatically backs the nut off the mandrel. It is claimed that the average operator can face from 600 to 700 ¼-in. to ¾-in. nuts per hr., and other sizes in proportion.

The machines are made with either belt or motor drive, and each machine is equipped with pump and countershaft, unless otherwise ordered. The No. 1 machine will face ⅜- to 2-in. nuts, and the No. 2 machine, 1- to 3-in. nuts. Both machines have the same dimensions, which are as follows: Height over all, 48 in.; height to center of spindle, 8¾ in.; length over all, 64 in.; floor space 3x6 ft. The spindles of the No. 1 and No. 2 machines have No. 4 and No. 5 Morse tapers, respectively. The bearings are babbitt with split cap boxes. Front bearings of both machines are 3 in. in diam. and rear bearings 2½ in. in diam. The cone pulley diameters are 12½x10x7½ in. for the No. 1 machine and 11x8½x6 in. for the No. 2 machine. The speed of the countershaft, which is driven by a 3-in. belt, is 250 r.p.m. The net weight of the No. 1 machine is 1,300 lb. and the net weight of the No. 2 machine is 1,400 pounds.

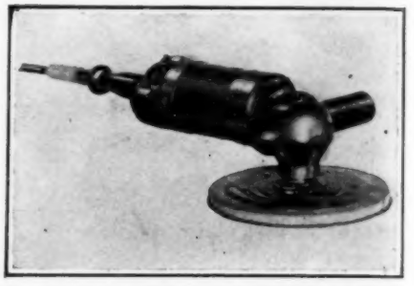
No. 9 "Hicycle" Sander

A direct motor-driven sanding disk of light weight, shown in the illustration, has been added to the line of "Hicycle" tools by the Chicago Pneumatic Tool Co., 6 East 44th St., New York, N. Y., for use particularly in finishing automobile bodies.

The motor is of the squirrel-cage induction type, without commutator



Victor Nut-Facing Machine



No. 9 "Hicycle" Sander

or brushes, and operates on a frequency of 180 cycles per sec. and 230 volts, 3 phase. A special motor-generator set or frequency changer is required for its operation. The rotor speed is reduced by means of spiral-bevel gearing, which also brings the driving spindle at right angles to the rotor shaft and the body of the tool. Two handles projecting at 90 deg. to each other in a horizontal plane afford convenient means for controlling the position and pressure to be applied to the tool. The cable enters through one of the handles and the switch is located near this point. The standard flexible pad is carried by the spindle at a high speed of rotation. The weight of the tool is 13½ pounds.

Stark Spiral Bench Milling Machine

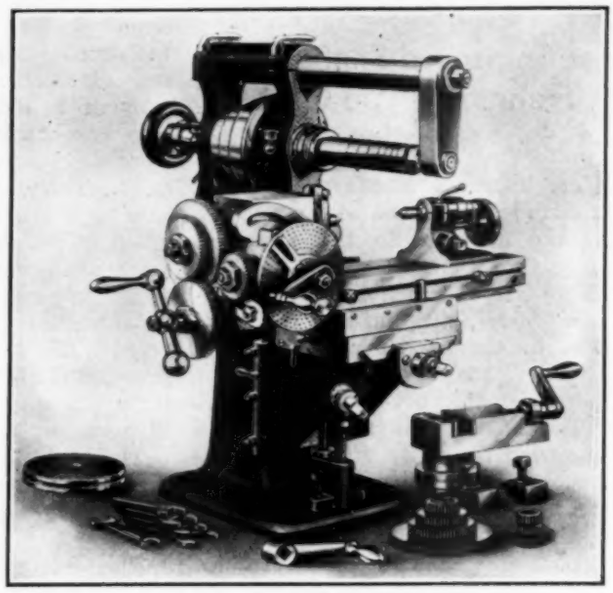
The spiral bench milling machine made by the Stark Tool Co., Waltham, Mass., and shown in the illustration, has a spiral-index head and swivel table. It will accurately cut spiral, spur, and bevel gears, twist-drill and tap flutes and perform many similar jobs of tool making. This machine, equipped with the vertical milling attachment, is also suitable for laboratory work, as it is capable of handling any milling work, within its capacity, with accuracy and facility.

The swivel table is accurately graduated and may be swung 45 deg. in either direction. The working surface is 18x4 inches.

The spiral-index head differs from the regular universal head in being equipped for carrying the change gears. It is of the 40-tooth worm-wheel type and may be set at any angle from 10 deg. below horizontal to perpendicular. Work up to 5 in. in diam. and 7½ in. in length may be swung between centers. The nose of

Shop Equipment News

the spindle has 10 N.F. threads $1\frac{3}{4}$ in. in diam. on the outside to receive faceplates or chucks. The inside is fitted to take the same No. 4 Stark collets as the cutter spindle. With the three index plates furnished all divisions to 50, and all even divisions to 100, may be obtained. The index table furnished gives all divisions obtainable to 312. A wide range of spirals may be cut by the use of the eleven change gears provided. Except for the size of the table, its graduated swivel, and the equipment of the index head, the machine conforms with specifications of previous bench machines made by this company. Regular equipment consists of draw-in spindle, swivel vise, a $\frac{3}{4}$-in. style-B cutter arbor, spiral-index centers, three index plates, a set of change gears, 2-speed countershaft, and wrenches. The net weight is 285 lb. and the space required is 28x24 inches.



Stark Spiral Bench Milling Machine

Zeiss Universal Measuring Microscope

THE Carl Zeiss universal measuring microscope shown in Fig. 1 is being marketed in this country by George Scherr Co., 142 Liberty St., New York, N. Y., for particular use in measuring screw threads. It has a much wider range than the Zeiss toolmakers' microscope previously described. Since projection methods cannot be used on a screw thread, the knife edge method has been incorporated in this instrument, as in the Zeiss screw thread comparator. Previously the hair line of the ocular was set by the fine line of contact between the knife edge and the side of the thread, which would allow some of the light to pass through and make it visible. A slight error is thereby introduced, caused by the phenomenon that reflections on curved surfaces tend to deflect a beam of light.

To eliminate this infinitesimal source of error, the hair lines in the microscope are now set by a fine line engraved on the knife edges at a given distance from and parallel with the edge, as indicated in Fig. 2. The measurement is thus taken from line to line, but no figuring is required, as the distance between the line and the edge is automatically compensated for in the ocular. These fine lines can be conveniently focused, as they are in the same plane with the centers of the instrument.

No screws are depended upon for measuring, but accurate glass scales in combination with an improved type of spiral ocular are used. All measurements are absolute, without reference to standards or gage blocks. The readings both for the cross and the longitudinal movement are each obtained in one single ocular. The smallest division on the scale reads to 1/20,000 of an inch. These spacings can readily be subdivided by the eye into 1/100,000 of an inch.

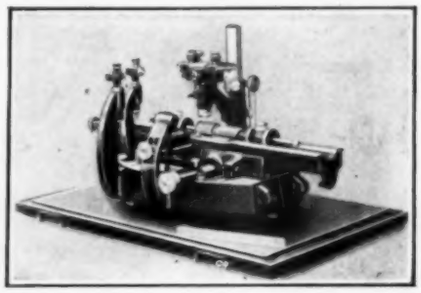


Fig. 1—Zeiss Universal Measuring Microscope with double tubus

The general construction of the instrument can be seen in Fig. 1. On a massive bed with column is arranged a cross carriage which floats in both directions on balls. Two carriages run at a right angle to each other, and for observing the travel of each, separate microscopes are provided. The cross movement serves for measuring the diameters, the longitudinal movement, the lead. Each carriage has both coarse and fine adjustment, and each glass scale has independent adjustment.

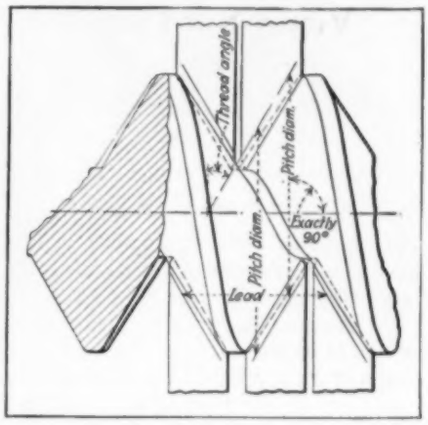


Fig. 2—Measurement of thread by knife-edge method

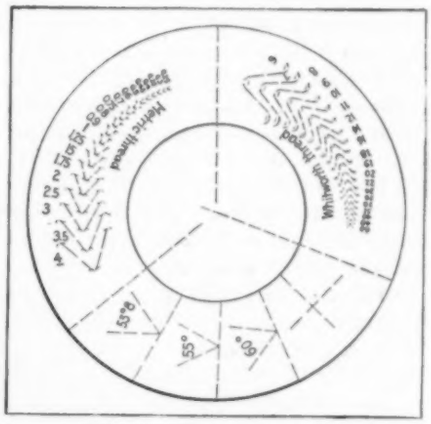


Fig. 3—Dial templet

Angular measurements are obtained with the universal protractor eye-piece, or by a revolving-type templet. Ordinarily, the microscope is equipped with a duplex microscope in the bracket, as shown in

Shop Equipment News

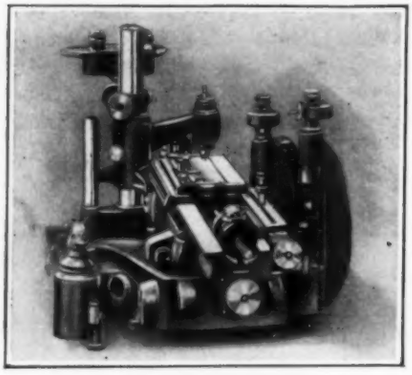


Fig. 4—Microscope with spotting device

Fig. 1. The left-hand ocular is the protractor eye-piece containing a templet with five parallel hair lines for measuring. The right-hand ocular is equipped with the revolving dial templet, Fig. 3, containing the contours of the standard U. S. and Whitworth thread against which the form of the thread can be readily checked.

The microscope bracket can be swung around the column 90 deg. against a stop, thus bringing a spotting attachment, Fig. 4, into line with the optical axis. In connection with this arrangement and with an auxiliary flat table, the instrument is very handy for laying out jigs and similar work. The top of the table is of glass and is arranged to swivel. This flat table is also required for any flat work, such as chasers, threading tools and the like, that cannot be held between centers or laid on the V-blocks.

The instrument is furnished as a screw thread comparator, containing the duplex microscope and knife edge equipment; as a large toolmakers' microscope; or as a complete universal measuring microscope, including all the available equipment.

SPECIFICATIONS

Maximum diameter measured	2 in.
Maximum lead measured	8 in.
Largest distance between centers	28 in.
Maximum distance under microscope	5 in.
Angular divisions on protractor eye-piece	5 min.
Guaranteed accuracy for length of 2 in.	0.00004 in.
Guaranteed accuracy for length of 8 in.	0.00016 in.
Total error of spiral microscope	0.00002 in.
Knife-edge error	0.00002 in.

Improved Shepard Standard-Type Crane Trolley

An improved standard-type electric crane trolley has been developed by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. The basic design, which includes a balanced drive, straight-line construction in units each separately accessible, and automatic oil-bath lubrication, has not been changed.

The load-carrying frame of the improved trolley is of all-steel construction, consisting of box-like sections. It is claimed that this frame, because of its composite construction, is free from shrinkage stresses and hence will not run untrue due to change of form.

The frame is carried by axle brackets made from heavy, seamless, drawn-steel tubes. The entire load-carrying structure, from trolley wheels to winding drum, is of steel.

The longer winding drum of the improved trolley permits grooving of a coarser pitch for a given size rope. The drums are cast on end of semi-steel.

Two optional types of mountings for the hoist motor are provided: The field frame of the motor may be bolted to an adapter ring or the base of the motor may be bolted to a horizontal shelf. The trolley motor may be mounted in similar alternative ways. Any type of motor of appropriate size, with solid or split frame, may be used.

The trolley axles are of heavy construction. The bearings are waste packed and supplied with oil cellars communicating with a pool retained within the axle bracket tubes. Oil for all four bearings is supplied through a single pipe connecting both axle-bracket tubes. The trolley wheels are securely fastened to the axles. The wheel at one end of each axle is pressed or shrunk on and the wheel at the opposite side is drawn on to a taper by a nut, which makes it secure yet easily removable. Although similar in design to former cranes, the gear train in the improved units is heavier, the gears are larger in diameter, and the ratios higher.

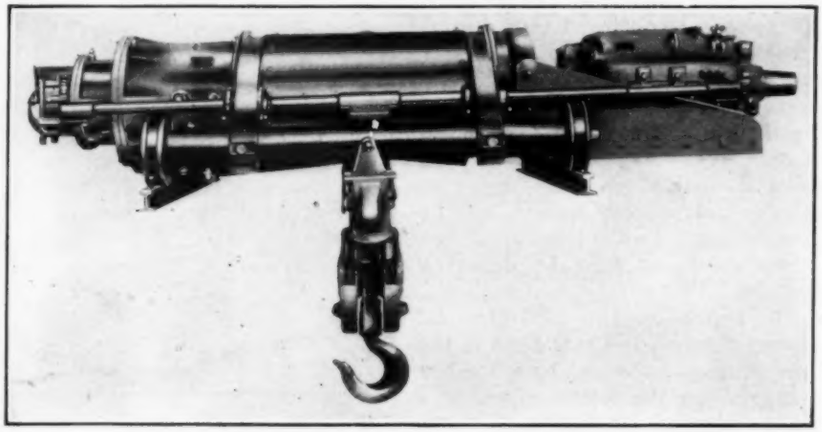
The load block is fully inclosed to prevent workmen from getting their hands caught between the rope and sheave.

The sectional construction of these crane trolleys permits each one to be built up of units suitable for the service intended. Steel-plate and angle construction of the body portion of the hoist frame, and axle brackets of steel tubing, permit special dimensions, when necessary, without making new patterns. Seven distinct types of crane trolley, of uniform design and improved construction, are available.

In developing this design, clearances have been made as small as possible and a special low-headroom type can be supplied.

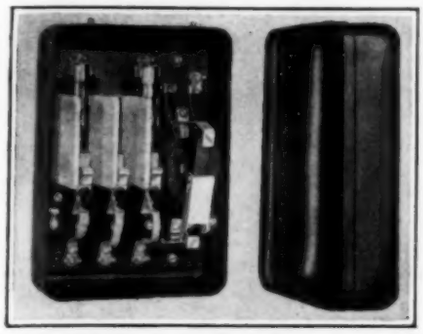
General Electric Magnetic Switch

To meet the demand for a small and cheap magnetic switch with temperature overload relays, the General Electric Co., Schenectady, N. Y., has designed a device bearing the desig-



Improved Shepard Standard-Type Crane Trolley

Shop Equipment News



General Electric Magnetic Switch

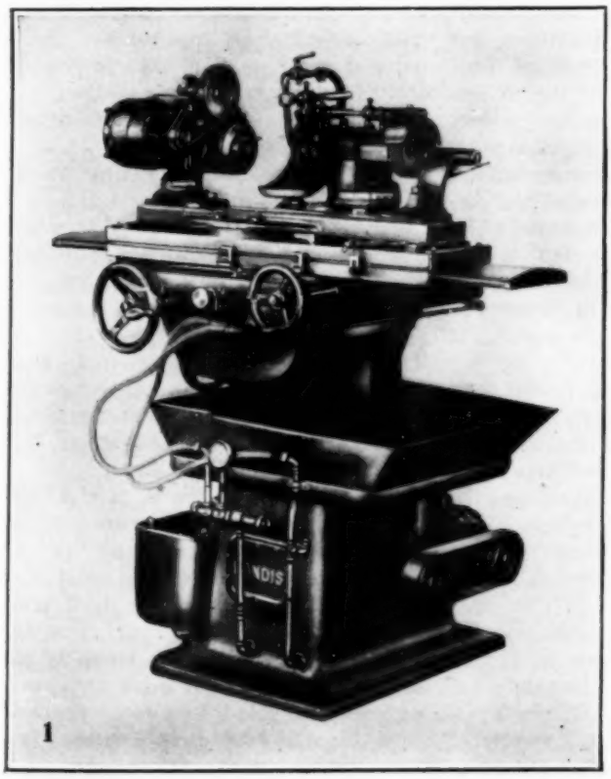
nation CR-7,006-D-20. This switch requires a very small mounting space, has a neat appearance both inside and outside, and is said to have many desirable electrical features. The inclosing case is of the drawn-shell type. During installation the base is removed from the case, thus making it easier to fasten the case to its mounting, install the conduit, and pull in the leads.

Large barriers are used to permit the switch to interrupt high currents. The electrical interlock is designed so that by removing a wire from the back of the base it is possible to use the switch on insulated circuits. Overload protection is provided by means of a Trumbull relay held in position on the panel by fuse clips. These relays can easily be changed to suit the size of motors involved. The relays are self-resetting and, therefore, the switch can be used with three-wire push-button control circuits only.

Landis Nos. 11 and 12 Tool and Cutter Grinders with Self-Contained Drive

THE Landis Tool Co., Waynesboro, Pa., has redesigned its Nos. 11 and 12 tool and cutter grinders for complete self-contained drive. Individual motors are furnished for the main drive and the work drive. The No. 11 machine is for plain work only, while the No. 12 machine is for universal toolroom work. The wheelspindle and traversing mechanism are driven by a 2-hp. constant-speed motor mounted on the rear of the base of the machine. The motor is belted by means of a double-V composition rubber belt to a shaft, in the base of the grinder, from which a 1¼-in. belt, passing through the hollow column, drives the spindle. This construction provides complete protection to the belt. A gravity idler pulley maintains the tension.

The headstock is driven by a ½-hp. constant-speed motor, through two belts and reduction pulleys, at a speed of 200 r.p.m. The motor is mounted in such a way that the full universal features of the headstock are retained. The headstock can be swiveled 180 deg. in either a vertical or horizontal plane. The hydraulic principle, which has been used on other types of Landis grinders, has been applied to these machines for operating the automatic table traverse. The oil reservoir is in the base of the machine and the oil is pumped from there to the reversing mechanism under the carriage. The oil pump is driven from the jackshaft in the base of the machine by a silent chain. Traverse speeds of 6 to 360 in. per min. can be obtained, and provision is made whereby the carriage will dwell at the reversal point to permit indexing the work. Automatic reversal is



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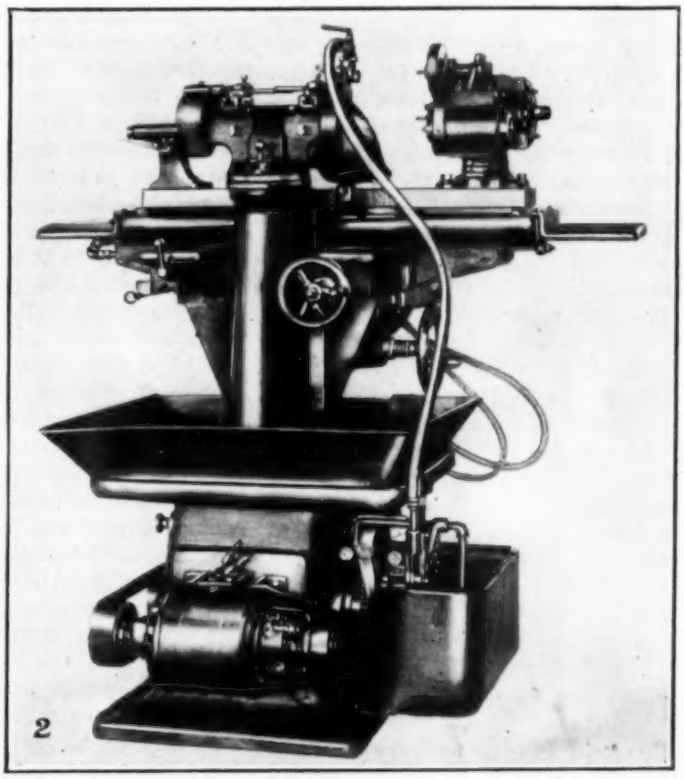

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Fig. 1—Landis No. 12 Grinder with complete equipment. Fig. 2—Rear view showing motor and coolant tank

Shop Equipment News

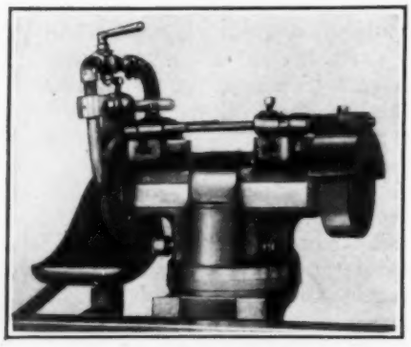


Fig. 3—Wheelhead with guards in place

also provided, or the carriage can be reversed by hand at any desired point.

The wheelhead is different from the one used on the overhead drive machine. The tapered bearings have been replaced by large cap bearings with laminated shims under the caps. The bearings are lubricated by means of felt wicks from reservoirs in the bottom sections.

The machine can be operated from the front or from either side of the column in the rear. Control levers and handwheels are all readily accessible, and the elevating and cross-movement handwheels are graduated in thousandths.

Except for the foregoing, the machines retain all the features of the original ones. The saddle is supported by two V-guides, 16 in. apart to prevent rocking. The double V-guides provide permanent alignment and automatic take-up for wear, thus eliminating adjustable gibs. The carriage is aligned with the saddle by V and flat guides of liberal dimensions. Special attention has been given to protecting moving parts from dust and grit, so that the machine will maintain its accuracy.

In Fig. 1 is shown a right-hand front view of the machine with complete equipment. Fig. 2 is a rear view, showing the mounting of the main motor, as well as the location of the coolant tank. Fig. 3 illustrates the wheelhead with all guards in place, and also shows the graduated base and the point where the head swivels on the column.

These machines have a longitudinal movement of 17 in., a cross movement of 9 in., and a vertical movement of 10½ in. Work 10 in. in diam. and 20 in. long can be swung on the work centers, and face mills up to 18 in. in diam. can be ground without the use of raising blocks.

Complete equipment of fixtures, attachments, and wheels can be furnished for performing the various operations in toolroom work. The No. 11 machine can be furnished with hand feed only, if desired.

Micrometer Hob Spindle for Lees-Bradner No. 5 AC Gear Generator

The Lees-Bradner Co., Cleveland, Ohio, has added, as optional equipment, a micrometer-adjustable hob spindle to its No. 5 AC gear generator previously described on page 547, Vol. 66, of the *American Machinist*. With the improved swivel head the hob may be adjusted in thousandths of an inch for shifting.

This adjustment is illustrated in the figure where the operator is shown releasing the clamp nut at the top and shifting the hob by means of the micrometer adjustment with his left hand. The clamps that hold the outer support of the hob arbor just below the hob, are first released to allow the slight change of position of the hob to take place after which these three clamping screws and also the clamp nut at the top are again tightened. The micrometer dial is shown just below the flange of the adjusting hand wheel.

Micrometer-Adjustable Hob Spindle for Lees-Bradner No. 5 AC Gear Generator

Niles Double-Frame Steam Hammers

A LINE of double-frame steam hammers has recently been put on the market by the Niles Tool Works Co., Division of the Niles-Bement-Pond Co., Hamilton, Ohio. These hammers range in capacities from 3,500 to 8,000 lb., and combine many interesting features. The illustrations represent a machine of 4,000 lb. capacity, but it is typical of the design of all sizes.

Owing principally to improved valve and steam passage design, it has been possible to obtain 30 per cent greater speed in operation than in former designs made by this company. Furthermore, forged and cast steel has been adopted as far as possible for the main members, and the conventional design of cylinder and frames has been departed from to secure additional strength and symmetrical appearance.

The hammer is of the double-acting type, and the length of stroke, position, speed, and intensity of blows are controlled either automatically or by hand by means of two levers, one controlling the operating and the other the throttle valve. The cylinder is a steel casting fitted with a cast-iron renewable liner, pressed into position, and is lipped down between the frames and held to them by eight alloy-steel bolts fitted into reamed holes.

The throttle and operating valve chests are cast integral with the cylinder, and the whole unit is self-draining. A safety cover is bolted on top of the cylinder and contains two heavy helical springs with bumpers projecting into the cylinder. These bumpers act as cushions and are placed to come in contact with the piston at its highest position. Springs are also furnished on the under side of the cylinder.

The operating valve is of the balanced-piston type and works in a renewable liner fitted in the cylinder. The vertical motion of the valve, by which steam is admitted, cut-off, and exhausted, is by a cam bearing on an incline in the ram. As there is no rigid connection, the valve and gear are not subjected to violent shocks. The throttle valve is of the rotary type.

The piston is forged integral with

Shop Equipment News

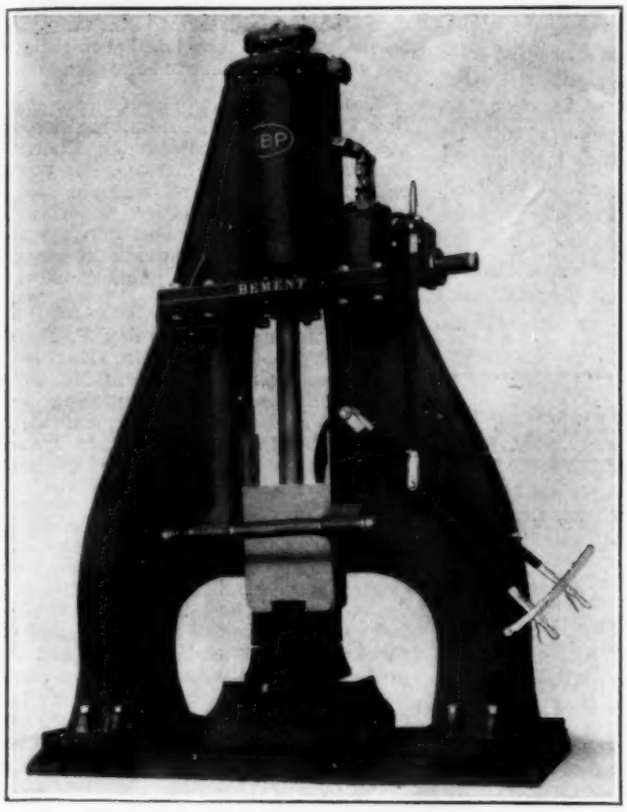


Fig. 1—Niles Double-Frame Steam Hammer.

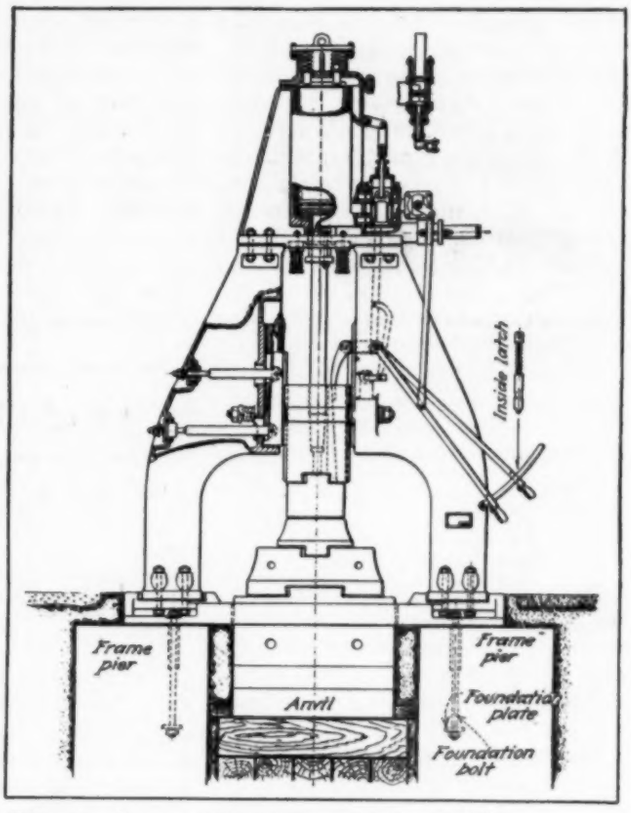


Fig. 2—Cross-sectional view of the machine

the rod and is of nickel steel. It can be raised above the top of the cylinder for examination or renewal of rings without separating the ram from the rod. The ram is made of carbon open-hearth forged steel. The piston rod is fitted into a taper hole in the ram, and a safety pin is provided to hold the ram and rod together.

The frames are heavy steel castings of box section. Greater depth of section and improved appearance are obtained by the elimination of the usual curved-frame design and the employment of a straight-line profile blending into a large radius toward the hammer base. The frames are lipped in the base and held together by tie bolts and distance pieces. They are held down on the baseplate by eight large bolts of special alloy steel, fitted in reamed holes.

The guides have a shoulder at the bottom so arranged that they cannot move vertically, but are free for horizontal adjustment by means of wedges. The guides and wedges may be removed without separating the ram from the piston rod.

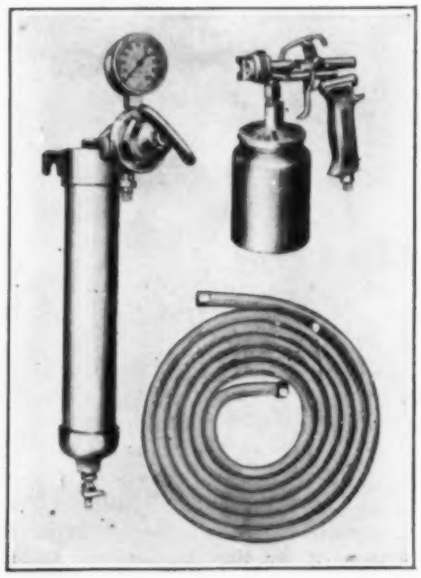
The anvil is a close-grained iron casting entirely independent of the baseplate. The anvil cap is an annealed open-hearth steel casting and is keyed to the anvil. It can be removed without disturbing the hammer. The anvil is provided with a tongue instead of the usual notch and the anvil cap is notched at the bottom to correspond. This cap, being of steel, offers greater resistance to breakage, but if damage should result, replacement can be made more cheaply and easily than in the case of a whole anvil.

Milburn Type E1 Paint-Spray Outfit

The paint-spray unit, shown in the illustration, is known as the Milburn Type E1 siphon feed outfit, has been placed on the market by the Alexander Milburn Co., 1416 W. Baltimore St., Baltimore, Md. This outfit, with which the Type E gun is furnished, is adaptable to a wide range of work. It is used for painting and lacquering automobiles, furniture, and for general, all-around work. It will operate efficiently using anything from heavy anti-corrosive paint to very thin lacquer. The gun can be adjusted for fine work such as touching up, shading, and high-lighting.

An ordinary garage air compressor affords a sufficient volume of air to operate the outfit.

It is claimed that the atomization



Milburn Type E1 Paint-Spray Outfit

Shop Equipment News

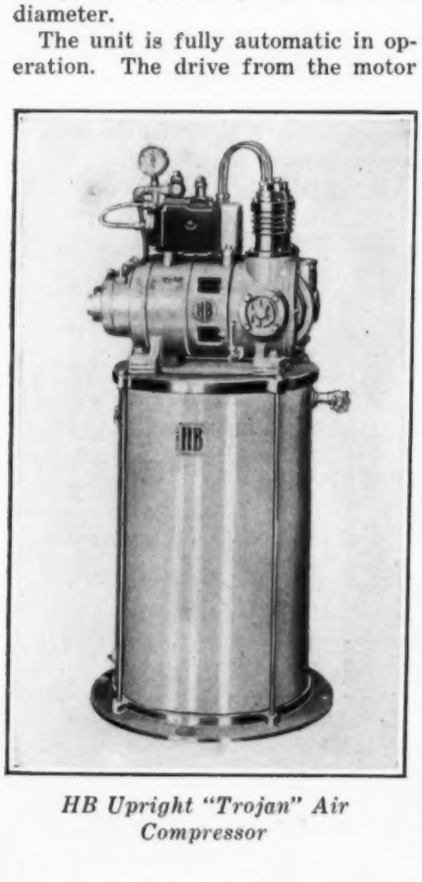
of the spray is so fine and even that "orange peel" is eliminated. The atomized spray is surrounded by an air pocket that lessens the loss of material by confining the spray to the work. An air purifier, which is essential for good results, is provided. The air, after entering, passes through a series of double baffles which extract moisture and other impurities from it.

The outfit consists of the Milburn type E gun with quart container, air conditioner, air regulator, and 25 ft. of air hose with the necessary connections. It is ready for operation when connected to an air line.

HB Upright "Trojan" Air Compressor

Hobart Brothers Co., Troy, Ohio, has added to its line of "Silent Twin" automatic air compressors the ¾-hp. "Trojan" machine shown in the illustration. Heretofore this model was put out mounted on a 22-gal. horizontal tank. In the outfit pictured, the compressor is mounted on a 26-gal. upright tank. This arrangement is said to conserve space, as the unit occupies a space only about 2 ft. in diameter.

The unit is fully automatic in operation. The drive from the motor is through a spiral bevel gear transmission. The motor is equipped with an automatic stop-and-start switch and has an automatic dial control that enables the compressor to start instantly without undue load on the motor or excess current on the line. Regular equipment includes an accurate pressure gage, air filter, oil and moisture drain, oil gage, check valve and safety valve. Seamless copper tubing is used for connections.



HB Upright "Trojan" Air Compressor

Trade Catalogs

Ball Bearings. The New Departure Manufacturing Co., Bristol, Conn., has issued leaflet No. 26, in which the use of ball bearings for milling machines, boring machines, production lathes, and grinders is urged. The bulletin is illustrated with cross-sectional views showing typical mountings.

Ball Bearings. The SKF Industries, Inc., 40 East 34th St., New York, has issued a new set of data sheets to replace those in the book "Engineering and Design," issued by this company several years ago. In order to introduce simplified practice, the bearings are divided into three classifications; preferred, non-preferred, and service bearings. The last class will not be sold for new work, but will be merely stocked for service replacement. Ratings and dimensions of a new series of angular-contact bearings are also given. A limited series of cylindrical roller bearings is also announced.

Blowers for Oil Burners. The American Blower Co., Detroit, Mich., has issued bulletin No. 1,033, describing Sirocco blowers for oil burners. The construction of the blowers is described and complete ratings and dimensional data are given. The blowers are for both household and industrial use. The publication is well illustrated with photographs.

Brakes, Solenoid. The General Electric Co., Schenectady, N. Y., has issued bulletin GEA-753, describing type CR9511 shoe-type solenoid brakes for direct-current motors. The description brings out the chief constructional features, and many photographs are used to indicate how the brake is installed.

Brass. The Chase Companies, Inc., Waterbury, Conn., has issued a 32-page booklet of its brass advertising cartoons, this being the fourth of a series. Besides being amusing, these little ads are full of information not only about brass but about general subjects as well.

Chucking and Turning Machines, Automatic. The Potter & Johnston Machine Co., Pawtucket, R. I., has published bulletin No. 82 describing its Model 5-D "Power-Flex" automatic chucking and turning machine. Constructional features of the unit are pointed out, and complete specifications are given. The leaflet is illustrated.

Comtor System. The Comtor Co., Box 215, Waltham, Mass., has issued publication H describing the Comtorgage for outside and inside diameters, and publication J describing the Comtorplug. These bulletins describe a series of instruments used in a system of checking and measuring developed by this company. The publications are well illustrated.

Dilatometer. The Stanley P. Rockwell Co., 66 Trumbull St., Hartford, Conn., has published bulletin No. 2704 on its dilatometer for tempering and annealing. Samples of typical work handled by this apparatus are given, illustrated by a photograph of the machine and charts produced by the recording apparatus.

Elevators and Conveyors. The Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., has published book No. 575 on its elevators and conveyors. It contains ninety-six 6x9-in. pages and is profusely illustrated throughout by photographs, usually two to a page, showing typical installations of the equipment. The various types are classified according to the material handled.

Flexible Shaft Equipment. The Stow Manufacturing Co., Inc., Binghamton, N. Y., has issued two bulletins on its flexible shaft equipment. In one the use and care of this apparatus is explained, and considerable engineering data and dimensional information are given. The other bulletin contains a complete price list.

Hacksaws. Henry Disston & Sons, Inc., Land Title Bldg., Philadelphia, Pa., has printed a complete list of its hacksaw equipment on cardboard suitable for wall mounting. Mailed with this card are two sample hacksaw blades, one the "Chromol" blade, the other the "Duraflex" blade. The text brings out the advantages of each.

Pamphlets Received

Pension Plans. The National Metal Trades Association, 122 S. Michigan Ave., Chicago, Ill., has published a study of employee pension plans prepared by its committee on industrial relations. The pamphlet contains sixteen 6x9-in. pages and is illustrated by several graphs. It is indexed. A review is briefly made of the four possible plans, and the method of financing them is gone into very thoroughly. The paper places great emphasis on the necessity for a sound analysis of the original plan and correct accounting methods so that failure due to lack of funds will not occur. Many questions that arise in connection with pension plans are answered under brief tabulated paragraphs.

NEWS OF THE WEEK

World Leaders Diagnose Economic Ills and Discuss Methods of Recovery

Forty-seven countries represented at conference

BY EDWARD J. MEHREN
Vice-President, the McGraw-Hill Publishing Company, Inc.

GENEVA, May 5, 1927.—For two days representatives of forty-seven countries have been listening to a diagnosis of the world's economic difficulties. Twelve countries have been heard from. The encouraging feature is that the diagnoses agree—surely a good basis for the discussion next week, in committee, of the details of remedies.

It is an interesting gathering. The Western world dominates in numbers, but even its composition shows variations that give the interest of wide diversity. The British and the French and the Germans are here in all their strength; but equally imposing in size of representation, by delegates and experts are Poland, Austria, Bulgaria, Esthonia, Hungary and Latvia, while Czechoslovakia outdoes all comers with the numerical strength of its expert group.

There are such other newcomers in the society of nations as the Free City of Dantzig and the Irish Free State. The British Empire registers strongly with its dominions and India; the Orient contributes Japan, China and Siam; Africa sends Abyssinia, while Latin America is well represented.

PROGRESS WITH RUSSIA

Then Russia is here. That was the high excitement of the initial days of the conference; looked on as a favorable omen. Not that anyone belives in the rapid conversion of the Bolshevists from their program; but they come, they listen, they confer—that is considered progress. Their country is looked upon as a formidable element in the economic world. If confidence in her government can be developed, trade will grow on that confidence and Russia with large consuming power could be an important factor in European recovery.

America's presence, too, brings frequent and highly commendatory comment.

Such, then, is the setting. Truly a "society of nations," as tongues other than English describe the League of Nations.

What is the diagnosis on which the speakers, each speaking for his delegation, so far agree? There are, so they indicate, a number of diseases: *First*, that purchasing or consumptive power was curtailed by the war; *second*, that many trade barriers, and not merely high tariffs, have been erected, such barriers as fluctuating exchanges, high freight rates, troublesome customs formalities, quickly changed tariffs, which discourage long-time contracts, etc.

Of these diseases the restriction of purchasing power was most frequently stressed, but suggested remedies were not so readily forthcoming. Prof. Karl Gustav Cassel (Sweden) in a learned address, intimated that the restored purchasing power of backward countries might be a powerful stimulus if capital for their development were forthcoming in larger volume; and Karl F. von Siemens (Germany), again by intimation, pointed out the burdens to industry caused by the expansion of government functions and government intervention in industry. Dr. Zimmerman (Holland) also developed the same thought. Enlarged government functions withdraw men from productive enterprise and make them a tax on industry and thus on consumption. Government interference also burdens industry. The result is the reduction of purchasing power. Among government interventions Herr von Siemens cited high customs tariffs not justified by natural differences, import prohibitions, export bounties and wage regulation. All these mislead industry into self sufficiency, discourage technical progress and, in sum, depress the standard of life.

As to trade barriers the International Chamber of Commerce, represented in the discussion by Walter Runciman, has proposed a well thought out series of remedies which have the concurrence of its twenty-two national committees in as many countries. Chief among these is a suggestion for stabilization of tariffs, that is, that tariffs shall not change too often and without due notice. On this subject there will be more later, when the conference resolves itself into committee.

Naturally the question of unemployment has been very fully traversed, for it is recognized as one of the most serious results of Europe's economic dislocation. It is inevitably tied up with lack of purchasing power and the remedy for the latter is necessarily found in the remedy for the former. But in the handling of this subject there has been a solicitude that goes beyond its consideration as a cold economic fact. The human distress is keenly felt and expressed.

Right here let there be recorded another note frequently struck in the speeches—insistence that the chief responsibility of leaders of industry and government is to improve the living conditions of the people at large. Whether this is a new note in Europe—a new note for the employer—I do not know. Certainly it does not accord with the impression we have in America of a cast-iron class distinction that refuses to recognize the ills of others. In Herr von Siemens' address this was especially striking. Again and again he came back to this as a major objective of those in responsibility whether in government or industry.

One other point secured universal agreement—that nations are interdependent and that their discolations react on each other. In fact the conference itself is the best evidence that the interdependence is a moving thought in Europe.

GERMANY ON CARTELS

Of tangible suggestions was Herr von Siemens' comment on the conditions necessary for international cartels, a subject sure to receive much discussion. He suggested that they were feasible only under three conditions: (1) that the industries in countries concerned must be accustomed to co-operate and come to an undertsanding; (2) that constituent national groups can only be formed where the number of those concerned is not too large and (3) that the agreements must cover a commodity which is clearly definable and also comparable.

Dr. Zimmerman stressed the growing importance for present industrial countries of their potential home market, since backward countries tend to establish their own industries and thus cut down their imports of manufactured goods. This means an effort to increase home consumption and therefore to raise the standard of living among the workers.

Mr. Jouhoux (France) proposed the organization of two economic bodies, one to meet at least every three years to lay out the policies for the second body, which would be a standing economic council to carry on, through committees, studies of important economic questions.

Finally, to an American, there was a special appeal in two points of Herr von Siemens' address: his appeal, first,

This is the first of a series of articles written for the *American Machinist* by Edward J. Mehren, who is attending the World Economic Conference as the editorial representative of the McGraw-Hill publications. Mr. Mehren's next article will appear in an early issue.

for the preservation of individualism and, second, for openmindedness and flexibility in one's economic and industrial attitude. One might have been hearing an American in the forceful statement that "economic and technical progress is achieved in the first place by the industrious and untiring work of the individual and by his belief in the success of his endeavors. If individualism is eliminated from economic activities there can be no economic life." He pointed out that large scale organizations endangered individualism and that a main concern of the manager of such an enterprise is to nurture individual effort and initiative. May not his commendation of openmindedness contain the secret of Germany's remarkable industrial progress before and since the war?

What will be the result of this world conference?

The question is asked and answered dozens of times each day between sessions and in hotel corridors. The answer is always the same: Do not expect too much. The problems are extremely complex. The solution must be worked out slowly. But the groundwork can be laid here. The superstructure will come at a later similar gathering. Despite the difficulty, though, some early results are possible and may be expected.

Walter Runciman (England) put the broad fundamental well in these words: "Those who are concerned to maintain business prosperity in all countries are convinced that a mutual understanding in international, economic and business problems is the surest guarantee for a growing volume of trade and for the maintenance of the higher standards of life and comfort which are the legitimate aspirations of modern democracy."

French Machinery Industry Must Modernize to Meet Competition

Increased protection planned in new tariff

By Our Paris Correspondent

IT appears to be beyond question that with the virtual stabilizing of the franc at twenty-five to the dollar, imports from abroad of all raw and semi-raw materials entering into the metallurgical, metal and metal working trades are on the increase. Stocks of these prime materials had been dwindling during the past six months. The new tariff project has not yet begun its retarding effect on manufactured imports; any slack which may have been noted in months past was due entirely to the unsatisfactory economic and financial situation.

The French manufacturer would like to fortify his sales campaigns abroad, knowing now virtually where he stands as to the cost of the bulk of his raw and semi-raw materials, his payroll and overhead. But there are still many side issues that cause a certain uneasiness as to the future of French export trade in machinery and machine tool lines. It is quite probable that during the past year, during the wildly fluctuating franc values, too many sales abroad were made with the sole idea of making, or holding, a market with less concern as to immediate profit than might otherwise have been the case.

Export Trade Lax

Actually, French export trade must meet the more efficient production methods of America, as well as the cheaper wage scale of Germany. Foreign trade has not returned the profits that might have been possible had it not been for such competitive factors as these. The excuse is offered that France has had to meet overproduction methods of Germany and Great Britain which has brought about something akin to dumping in many world markets. During the coal strike in England, moreover, that country was buying more in the French market than it is today. The Chinese market has shrunk notably in the last six months.

The home market shows, by reference to car loadings since the first of the year, that it too has drawn in, but indications of the past six weeks point to improvement. Orders have appeared here and there where they had been lacking, but these chiefly bear on minor items rather than those running to big money.

The automobile industry is still in a quandry as to the future. The Citroen plant, in spite of a brave effort a couple of months ago, has laid off ten thousand workers. The building hardware trades and manufacturers of hand tools and small machinery parts, however, are improving their positions, Railway supplies and those called for by the shipbuilding trades are enjoying increased demand.

Unemployment has been reduced to a visible extent in most of the big production centers. The grave question for the wage earner just now—and the reaction on the employer will not be long in coming to a head—is that of the still rising cost of living. The specialist worker in the machinery trades of the Paris district has seen his index of living costs of 100 in 1914 rise to 335 in 1920, and 502 in January, 1927. It may be further said that costs are still rising, above all on most items affecting the workingman. Increased output for his 212 working hours per month or more efficient machinery, replacing manual labor in all lines are the two possible solutions. Big business seems to realize this, but the small manufacturer is powerless for the moment to reduce production costs by such methods.

In spite of the crisis which the automobile trade is undergoing, it is altogether creditable that the larger firms are making serious efforts toward standardization. It is claimed that the ball and roller bearing manufacturers are actually cataloging over six hundred varieties, whereas it is believed that this number might be reduced to one hundred and fifty. Current models of automobiles show nearly a hundred forms of brake shoes and linings, and fifty-eight varieties of disk clutches. There are not so many makes and models of automobiles in France but that it is conceivable that manufacturers might get together and standardize these items to the financial benefit of all concerned.

Undoubtedly, it is in the automobile and electrical industries that standardization will first come to pass. The government shipbuilding yards have made an effort in this direction. It will soon be the turn of railway motive power and rolling stock to follow suit if any great national economies are to be made which will reach the country's entire population.

The new customs tariff as proposed is believed to have serious designs on machinery and tool imports. This has proved to be the case each time France has revised the old tariff by the complicated co-efficient method of multiplying percentages. Going to the depth of the question it is found, however, that, on machine tools, the French tariff is far below that of Italy or Spain. France still contends that her tariff is the most moderate of continental Europe, but as against this must be lodged the fact that it has become a protective tariff, not one for revenue alone. Furthermore, there are two distinct issues running side by side and being pushed to as high a limit as possible—agricultural protection and industrial protection, each hitting the consumer hard.

It is to be noted that in March the import of "materials employed in industry" showed an increased tonnage of 181,387 metric tons over the same period last year. Were the comparison made in values it would be less imposing, given the improved value of the franc; as it is it is something to ponder over. The first quarter of the present year, as a whole, showed a falling off in the values of imports of raw materials for industrial uses of 20 per cent from last year, and as an obvious result the reflection is found in the practically stationary exports of manufactured articles.

Hand-to-Mouth Buying

In all lines of small tools and machinery buying is still only for pressing needs from day to day. The crisis may well be thought to be passed, but the distributor and consumer alike are still awaiting economic developments which will enable plants to get once more into full operation. Garden tools and small agricultural machines alone appear to have leveled up to spring expectations. Heating appliance manufacturers are already at work on output for next winter's business and annual increases in the use of all forms of "central-heating" methods are opening up new markets for tubes, joints, valves and the like, as well as boilers. The business is largely one of assemblage of parts bought on price offers, but is a fast growing one which in course of time will require more and more special equipment on its own account.

Many Recommended Practices Adopted by Gear Manufacturers in Tenth Anniversary Meeting

Six new member companies elected—attendance large

EIGHT proposals of sub-committees were adopted as recommended practice by the American Gear Manufacturers' Association at its eleventh annual meeting held in Jackson, Mich., May 12, 13, and 14. These standards had previously been approved by the General Standardization Committee, of which B. F. Waterman, Brown & Sharpe Manufacturing Co., is chairman. In addition to the recommended practice there were approved, proposed suggested standards for nomenclature and a revision of earlier recommended practice for the design of worm gearing. There were also progress reports from several of the sub-committees.

Registration of one hundred and twelve members and guests made this convention one of the best attended in the history of the organization.

President Frost, of the Frost Gear and Forge Co., welcomed the delegates to Jackson in an address that pictured the objects and activities of the association and indicated a sound program for the future. "Standards and Specialization," was the title used by Mr. Frost. In referring to standards he said, "The work that we have done along the lines of technical standardization has been so thoroughly broadcast through the courtesy of our good friends of the technical press, and you who are members of the association have been kept so well informed through our secretary's office, that I should feel your time was being wasted were I to dwell upon past accomplishments. Certainly we have done much and I want to again bestow praise upon those of you who have so faithfully and patiently toiled for the welfare of the association." The chief portion of the address, dealing with specialization, is abstracted on the following page.

Other speakers presented papers or made addresses during the convention. Perry L. Tenney, of the Muncie Products Co., read a paper, "The Equilibrium Factor in Gear Shifting." Douglas T. Hamilton, of the Fellows Gear Shaper Co., presented a paper, "Gear Nomenclature. Where Does It Lead Us?"

Talk on Teamwork

Professor Dickinson, of the University of Michigan, spoke on the advantage of giving foremen and other workers the opportunity to voice their suggestions, and outlined several methods of making rewards for suggestions. The title of his talk was, "Teamwork in the Manufacture of Gears." Dr. Frederick Spence, of Jackson, was the chief speaker at the banquet. His topic was, "Some Needed Emphases in Industrial Relations." B. Wheeler, of the Railway Equipment Engineering Department of the Westinghouse Electric and Manufacturing Co., presented a paper, "Normal Pitch Measurements," which dealt with the measure of normal pitch of ground, unground, and heat-treated gears.

F. W. Sinram, of the Van Dorn & Dutton Co., honorary president of the association and its president during the first six years, was toastmaster at the banquet. Mr. Sinram recalled the organization meeting, giving the roll call of the representatives present at Lakewood, N. J. Victor Beam, patent attorney, of New York City, who was instrumental in organizing the society, spoke at the banquet.

A. A. Ross, of the General Electric Co., was the only new member elected to the executive committee. F. W. Sinram; H. E. Eberhardt, of the Newark Gear Cutting Machine Co.; and A. F. Cooke, of the Fawcus Machine Co., were re-elected to the executive committee.

Instead of electing the president immediately after the election of members of the executive committee, it was decided to hold a meeting of the executive committee about thirty days after the annual meeting at which time the president will be elected.

New Members Admitted

The six new member companies and their executive representatives are:

Federal Gear Co., Cleveland, Ohio, H. L. Stinard.

Springfield Manufacturing Co., Springfield, Ohio, William P. Metz.

Citroën Gear Corporation, Paris, France, Andre Citroën.

Charles E. Crowfoot Gear Corporation, South Easton, Mass., Charles E. Crowfoot.

Formica Insulation Co., Cincinnati, Ohio, R. W. Lytle.

Copland Gear Lapping Syndicate, Detroit, Mich., A. W. Copland.

Following is a list of the items for which recommended practice was adopted:

Tooth Proportions of and Discard Gages for Long and Short Addendum Railway Helical and Spur Gears; and Web Holes for Railway Gears (both the work of the Gears and Pinions, Electric Railway, Mill and Mine Committee, W. H. Phillips, R. D. Nuttall Co., chairman).

High-Speed Herringbone Gears or Herringbone Gears Operated at Speeds in Excess of 4,000 Feet Per Minute Pitch Line Velocity (work of Herringbone Gear Committee, A. F. Cooke, Fawcus Machine Co., chairman).

Standard Keyways for Holes in Gears (work of Keyway Committee, R. B. Zerfey, Tool Steel Gear & Pinion Co., chairman).

Forged and Rolled Carbon Steel for Gears (work of Metallurgical Committee, C. B. Hamilton, Jr., Hamilton Gear & Machine Co., chairman).

This committee also presented revised recommended practice for bronze and brass castings for gears.

Commercial Spur Gearing Backlash Measured on Standard Center Distance with Feeler (work of Spur Gear Committee, J. L. Williamson, Fellows Gear Shaper Co., chairman).

14½-Deg. and 20-Deg. Full Depth Tooth Systems (work of Tooth Form Committee, H. J. Eberhardt, Newark Gear Cutting Machine Co., chairman).

Revisions of recommended practice submitted by the Worm Gear Committee, J. C. O'Brien, Pittsburgh Gear and Machine Co., chairman, were adopted. These revisions are concerned with the design of worm gears using existing hobs and design of worm gears for which new hobs are to be made.

A revision of the recommended practice for computing the horsepower of non-metallic spur gears composed of laminated phenolic materials or rawhide was adopted. The formula

$$\frac{600}{600 + PLV}\ 6{,}000 = SWS$$

was changed to read

$$\left(\frac{150}{200 + PLV} + 0.25\right) 6{,}000 = SWS.$$

This revision was the work of the Non-Metallic Gearing Committee, T. C. Roantree, Westinghouse Electric and Manufacturing Co., chairman.

Nomenclature offered by the Nomenclature Committee, D. T. Hamilton, Fellows Gear Shaper Co., chairman, was accepted as Proposed Suggested Standard for future design for spur gears. This nomenclature, after slight revision by the committee, will be published in the *American Machinist*.

Progress reports were received from the Bevel and Spiral Bevel Gear Committee, F. E. McMullen, Gleason Works, chairman; the Differential and Transmission Committee, S. O. White, Warner Gear Co., chairman; the Inspection Committee, F. G. Eppley, Albaugh Dover Manufacturing Co., chairman; the Sprocket Committee, G. M. Bartlet, Diamond Chain and Manufacturing Co., chairman; and the Spur Gear Committee, J. L. Williamson, Fellows Gear Shaper Co., chairman.

Test Reports Ready

E. W. Miller, chairman of the A.G.M.A. Research Committee on Gears, announced that the fourth progress report of the tests being conducted at Massachusetts Institute of Technology was available. This work is being carried on under the direction of Professor Earle Buckingham.

The usual splendid features of entertainment for the ladies had been prepared by the entertainment committee, Charles J. Goedke, of the William Ganschow Co., chairman.

One of the most interesting features of the convention was an inspection trip to the University of Michigan at Ann Arbor, where particular attention was paid to the research work on gears being conducted in the Department of Engineering Research. This work, under the direction of Professor White, is pointed toward determining the causes of noise in running gears and finding methods of preventing it. The university is well equipped to carry on this work and has already made appreciable headway.

Development of Gear Making a Benefit to Entire Machinery Industry

Abstract of President Frost's Address

WE ARE gear-makers today and fifteen or twenty years ago went by the same name, yet what a difference in skill, knowledge and refinement.

Chemistry, so far as our craft was concerned was almost unheard of, alloy steels unknown as we think of them today, and the microscope an enigma so far as its revelations went.

Today there is an insistence for better steels and other materials used in gears, and new alloys are continually being developed along with new methods of surface hardening to meet this demand.

Greater tensile strength and resistance to wear and fatigue are constantly sought and both steel-mill and heat-treating plant are importuned to exert their best endeavors to furnish a product that will be satisfactory.

Credit the Automobile

While the automotive field has been largely responsible for this state of things, we must realize that they have merely pioneered the way and that other types of machinery are profiting by what has been accomplished and never again will be content to use what a few years ago was considered good practice.

We have been compelled to establish chemical and physical laboratories and to resort to the use of powerful microscopes to safeguard our customers' interests in the selection of our materials of construction.

For many of us, installation of expensive and extremely sensitive pyrometer systems has been made necessary by the exacting conditions, in order to secure from the materials employed, the very maximum of endurance.

Men, such as were not available a few years ago, have had to be technically trained and then given shop experience to fit them for the task at hand.

Electrically heated furnaces, on account of accuracy of control and uniformity of product, are taking the place of types hitherto used, sometimes at tremendous outlays of capital.

Shop equipment has undergone such marvelous improvement in many lines, that it is now often producing better work at greatly increased speeds and this in turn makes shop managers stand aghast at the havoc played with inventories that a short time ago stood as a valuable asset on the ledger of shop machinery, but now of problematical worth, though maybe far from worn out.

And back of all this hovers, like a wraith, the possibility of changes in types of product, which may call for installing an entirely new set of machines, radically different in construction and relegating to subordinate use, or perhaps even the scrapheap, otherwise useful equipment.

When we come to consider the things just mentioned, we must naturally arrive at the conclusion that, considering the skill, experience and monetary risk involved, we, an important industry, are not receiving a just return.

Many of us, due to the insistence of our customers, have from time to time increased our shop equipment, until now we are fitted to accept contracts of large proportions.

In the meantime customers, possibly laboring under the impression that they are passing up potential profits by not making their own gears, are installing gear making machinery, and I fear, in some instances, juggling shop costs by side-stepping such items of overhead as supervision, laboratory expense, inspection, and spoiled work in an effort to justify the investment.

Then, too, every little while instances are found where a quality of material or workmanship or of both is permitted to go into the final assembly, that would not be tolerated with purchased goods, simply because it hurts to throw away gears made in their own shops—a condition that should not and would not pertain if a fair minded analysis were made of quality and costs.

Fault finding, however, with existing conditions, will not do us much good, and if we cannot convince our customers, present and potential, of the truth of the statements just made, it would seem the wise thing to study materials, men, equipment and management with an earnestness of purpose perhaps never before manifested, hoping that efficiency rather than argument will keep our facilities employed.

Standardization Has Aided

Our work on standardization ought to be the means of great saving to us and also of immense economic value to industry in general and possibly may be a saving factor in helping us to secure and maintain a reasonable margin of profit.

Unquestionably industry is slowly coming to realize the waste that comes from attempting to supply gears made from six or eight different alloys of steel where one would serve the purpose as well, and, in the interest of manufacturing economy, it might be well for us and especially our metallurgical committee to give this subject careful consideration, having in mind recommending one alloy as being well or best suited to a given purpose.

While this action would undoubtedly find disfavor with makers of certain alloys whose type of product did not happen to be the one selected, I still believe it should be done in the interest of economy, as it would cut down very materially the stocks of steel now necessary to be carried, not only by ourselves, but by the various forge companies as well.

The use of a narrowed selection of steel compositions would also tend to improve the quality of heat-treating to be done due to greater familiarity.

In our struggle to get a fair share of business and maintain a reasonable profit, it would seem that we as specialists ought to be the first to more thoroughly study the subject of manpower, having in mind that it has been stated by those who ought to know, that altogether too little thought is given to this important subject in comparison with our readiness to spend money freely for new buildings, equipment or sales campaign. Certainly it has been proved time and time again that by proper training, encouragement and square dealing, results have been obtained that were undreamed of a decade ago.

We should know enough of "rough and ready" psychology to pick men suited, in fair degree at least, to the tasks which they are to perform, and the supervision should be such that they are well instructed in any of the minutia of their jobs with which they are unfamiliar.

Loss of production due to and compensation paid for industrial accidents form an appreciable addition to the already high rate of overhead with which most of us are familiar. In this State and probably some of the others here represented, compensation expenditures are on the increase and should be carefully watched as being among the many items constantly crowding us toward red figures in the annual statement. Aside from our selfish interest, the humanitarian side of the question should lead us to do all we can to safeguard and educate our employees against the fearful toll of life and limb that in the national aggregate is appalling.

Metric Proponents Again Active

Failure of Congress, at many sessions, to give serious consideration to metric legislation in no way deters its advocates from continuing their efforts to secure some form of federal compulsion intended to require further use of this system of weights and measures. Representative Britten, of Illinois, has announced that both he and Senator Gillette, of Massachusetts, will reintroduce their metric bills and will press them for consideration at the new Congress which assembles Dec. 7.

So well conducted has been the propaganda in favor of the metric system that the average new member goes to Congress with a hazy idea that a change in the system of weights and measures would be a progressive step. The legislative effort always has run the same course. Advocates of the metric system have influence enough with committees having jurisdiction to arrange public hearings. The supporters of the system present their views first. This is done with such skill that the new members of the committee usually are impressed with the possibilities of the scheme. Then the advocates of the retention of the system which the country has used since its origin have their innings. Most of the contentions of the metric witnesses are quickly knocked into a cocked hat. In recent years this has been done so effectively that the committee does not go to the trouble of formulating a report of its conclusions.

Conference Board Sees Optimistic Future

At its eleventh annual meeting, at the Hotel Astor, New York, on May 19, the National Industrial Conference listened to addresses on current industrial problems by members of its own economic staff and by prominent outside authorities. Loyall A. Osborne, chairman of the board and president of the Westinghouse Electric International Corporation, presided at the meetings and at the dinner that followed. In the absence of the president, Magnus W. Alexander, who was confined to his home by illness, his address, "American Industry at a Turning Point," was read by Mr. Friedell.

Virgil Jordan, chief economist of the staff, gave his views on business conditions and trends and proved to be distinctly optimistic. His studies of underlying business conditions during the last two years indicate that with the exception of stocks and real estate the market has been normal or subnormal rather than expanded. He anticipates readjustments in stocks and real estate and improvement in manufacturing and trade.

The fiscal problem of the nation was discussed under two heads: "Does Industry Shift Its Taxes?" by J. Frank Zoller, tax attorney, General Electric Co., and "The Present Cost of Government," by W. J. Schultz, economist of the board's research staff. Other speakers were Henry D. Sayer, executive secretary, New York State Industrial Survey Commission, "Can Industry Put Its House in Order?"; Arthur H. Young, industrial relations counselor, "Social Implications of Industrial Relations Work"; Myron W. Watkins, economist of the research staff, "Have Industrial Combinations Benefited American Economic Life?"; William E. Wickenden, director of investigation, Society for the Promotion of Engineering Education, "Training Industry's Technical Personnel."

At the dinner, Charles Cheney, vice-chairman of the board and president of Cheney Brothers, acted as toastmaster. Addresses on "The Awakening of Asia" were given by Dr. P. W. Kuo, president of the Southeastern University of Nanking, and Dr. James M. Yard, secretary, West China University.

Art in Machine Design Exposition in New York

Beauty and art in machine design is advocated at the Machine Age Exposition now in progress at 119 West Fifty-seventh St., New York. The exposition is being held under the direction of the editors of the *Little Review*, a magazine devoted to art, who are being assisted in the work by various professors, artists and architects.

The idea behind the exposition is stated to be a desire to interest designers in a greater desire for beauty in the design of all types of machinery, extending this also to the construction of factories and buildings for the housing of workmen. It is recognized that some designers are already incorporating the principles of art, and some small commercial machines, valves and fittings are shown that have beauty of form as well as utility. The advances made by the automobile in this respect are shown in pictures. The exposition includes a demonstration of the work being done by the Russian government in rebuilding manufacturing plants and in the building of collective homes for workmen. The exposition will be continued until May 28, and will be an annual event.

Steel Treaters Discuss Technical Problems

Discussions of important technical subjects featured the spring sectional meeting of the American Society for Steel Treating, held May 19 and 20 at the Pfister Hotel, Milwaukee. Approximately 200 members attended.

The meeting was divided into three technical sessions, presided over by Dr. J. A. Mathews, Prof. H. M. Boylston and Dr. F. C. Langenberg, respectively. The papers presented were: "Scientific Research and Its Application to Industry," by T. McLean Jasper, director of research, A. O. Smith Corporation, Milwaukee; "The Automatic Electric Furnace—Its Uses and Possibilities," by Harold F. Wood, chief metallurgist, Ingalls-Shepard Division, Wyman-Gordon Co., Harvey, Ill.; "Heat-Treatment of Wrought-Aluminum Alloys of High Strength," by R. S. Archer, research bureau, Aluminum Co. of America, Cleveland, Ohio; "Application of Theory to Practice in Heat-Treatment of High-Speed Steel," by R. M. Sandberg, assistant manager, Columbia Tool Steel Co., Chicago Heights, Ill.; "Case Carburization of Steels by Means of Salt Baths of Low Cyanide Concentration," by H. B. Northrup, J. W. Kelley Co., Cleveland, Ohio; and "Processing Welding Wire and Its Effect on the Flow of Welding Metal," by J. B. Green, research department, Chicago Steel and Wire Co., Chicago, Ill. At the banquet, the two speakers heard were S. M. Havens, general manager, Ingalls-Shepard Division, Wyman-Gordon Co., Harvey, Ill., and Dr. Max Mason, president, University of Chicago.

In his talk, Mr. Jasper mentioned that the five things necessary for thorough research are understanding of nature's laws, logical deductions, application of analysis and anology, patience and diligence, and sense of proportion.

Mr. Wood, in his paper, described an automatic heat-treating installation consisting of two rotary-hearth electric furnaces for hardening and drawing respectively, arranged with automatic charging and discharging devices, an automatic quenching mechanism, and transfer conveyors. In discussing the heat-treatment of aluminum alloys, Mr. Archer mentioned that there were three processes utilized; annealing, solution heat-treating and precipitation heat-treating.

In outlining the characteristics of welding wire, Mr. Green made use of slow motion pictures taken on a special film under infra-red light.

Foremen Need More Help —and Less Hell

Greater consideration of the individuality of foremen and workmen was summed up in the statement of T. B. Fordham—"the foreman needs more help and less hell"—meaning that fault finding and continual criticism is not the way to encourage the foreman and make him interested in the success of his department.

This was one of several points made by prominent manufacturing executives at the fourth annual meeting of the National Association of Foremen, held in Cincinnati on May 21. Mr. Fordham, who is president of the association, was in charge of the meeting and delivered the main address. The general topic was "The Foreman as Business Manager of the Department."

Mr. Fordham dealt mainly with the human side of the foremen's job. He pointed out changes in the past twenty years, from the old days when a foreman had the power only to hire and fire. Foremen's clubs, he said, have done much to encourage knowledge of the various phases of shop activities that go to make up modern industry. He pointed out the need for really constructive programs rather than the stressing of the social side. The foreman must consider the return to the investor in the business, to the workers and to the users of the product he is building. Best results always come when the workmen like their jobs.

Charles R. Towson told of the necessity for loyal co-operation between the foremen and the workmen. He pointed out the better results obtained when workmen were interested in the job and were mindful of the responsibility given to them. He suggested that foremen ask themselves whether the job they are doing brings them close enough to the work and to the men. He urged that workmen be made more familiar with the plant so far as possible. He cited a case where a man had worked fifty-two years in one shop, but who had never been through it.

Another speaker was Meyer Bloomfield, well known student of personnel and industrial relation problems. He urged that higher executives come to a realization of the changes in manufacturing conditions, and the necessity of keeping in close contact with those who are in direct charge of the men in the shop. He cited two instances where only close co-operation between departments — executive, engineering, production and sales — had avoided disaster when radical changes had come suddenly in the business.

"Personal Qualifications for Foremen" was the subject of an address by Frank D. Slutz, who gave a very complete and convincing analysis of this important phase of the subject.

The meeting closed with a banquet at which Prof. G. W. Dyer was the main speaker. The newly elected officers are: E. F. Myers, of French & Hecht, Springfield, Ohio, president; Harry Croner, of McGee Bros., treasurer; and E. H. Tingley, secretary. The next annual meeting will be held in Canton, Ohio.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

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IN ITS details the business situation changed but little last week. The stock market was fitfully firm, the commodity markets were normally responsive to seasonal influences, car loadings seem to connote a distributive trade that equals last year's and bank clearings continued to run ahead of 1926, although the increase is chiefly due to the large turnover of stocks and bonds.

But in the background of the picture there are some features that the thoughtful observer cannot ignore in attempting to reach an intelligent conclusion with regard to the future. One of these is the action of the Interstate Commerce Commission in vetoing what is called the Loree railroad consolidation. Railroad stocks have been heavily bought upon the theory that their value would be increased by bringing many properties into combination. Thus far none of the combinations proposed has been effected, and in the stock market it is particularly true that "hope deferred maketh the heart sick." Another is the fear of inflation. This has been revived by the heavy importations of gold recently reported, as well as by the action of the Federal Reserve Banks in purchasing $59,000,000 of gold that is held in London and the fact that the European banks are increasing their holdings of the yellow metal despite our heavy acquisitions. Just where all the gold is coming from no one knows but there seems to be some warrant for the assumption that the quantity hoarded during the war was much larger than anyone supposed, and that with the return of confidence it is being exchanged for paper money. If this theory is correct it means an addition to the world's bank reserves and a corresponding increase in the supply of credit as well as a further decline in interest rates.

It is upon this expectation that speculators are buying stocks and bankers are bringing out new loans with a rapidity that is almost startling.

But several economists are beginning to point out that the ease with which money is obtainable has its disadvantages in that it will lead to over-development and over-production. Much over-production is in fact already evident. The most conspicuous example of this is the oil industry. Its leaders are making valiant efforts to restrict the output but they have not yet succeeded in getting anything like unanimous consent to the appointment of a "Czar," which is the modern method of dealing with such situations.

In the cotton textile business the conditions are not dissimilar and at Atlantic City last week Mr. Hines, the newly elected president of the Cotton-Textile Institute, warned the assembled manufacturers that night work was undesirable because it might result in over-production.

The automobile industry, the steel industry, the woolen industry and the coal industry are in the same predicament. Capacity production would greatly exceed the consumption and it does not appear that the latter would be greatly increased, even if prices were cut in half.

A satiated appetite is not whetted by a reduction in the cost of food, and in this country we appear to have reached a point at which some new outlet for our increasing production must be found if our workers are to have full time employment at the wages to which they have grown accustomed.

This is the "Dilemma of Thrift" so much talked about since the book was published. It presents a problem that its proponents call "Under-consumption" but it is better described as "Overproduction" at a time like the present when nearly everyone who is able to work can make enough to buy pretty much all he needs. In so far as the United States is concerned a solution will be found when we can compete with the rest of the world in supplying the needs of other countries than our own. Until then we cannot expect much further expansion in our domestic trade, and we should be prepared for brief periods of arrested development.

Meantime we may get more or less stimulus from adversity and particularly from the disastrous flood in the Mississippi Valley.

It has caused much suffering and distress but it has also advanced the price of cotton and the replacement work it has made necessary will involve an enormous expenditure and provide work at good wages for an army of men. When the water and the excitement subside we shall know whether the advance in cotton has been fully justified. Until then the sellers are likely to be few. The other commodity markets have moved within such narrow limits that comment is unnecessary. Sugar has yielded slightly upon the announcement that Suzuki & Co. were long 350,000 tons of Java sugar. Their commitments have been taken over by other concerns but their gradual liquidation is expected and upon this expectation the market is hesitant.

In its entirety the outlook is in fact more satisfactory than it seemed reasonable to expect a few weeks ago, and while it still includes factors that may be troublesome there is nothing that promises to be disturbing.

WHAT'S DOING IN INDUSTRY

MORE than one bright spot appears in the machinery and machine tool industry throughout the country. The general market condition is featureless, but sales are steady, even though in small volume. Inquiries have become negligible, making the selling effort more intense and keeping dealers and agents continually on the job to unearth new sources of business.

CHICAGO reports a slight improvement, with railroads showing activity and a brighter outlook is forecast. Cincinnati is dull as buyers remain cautious and orders are held up. A spotty condition prevails in Cleveland, but Milwaukee is busy on old bookings. Railroads and automobile body plants are furnishing some good business in Indianapolis. A noticeable change for the better is seen in Detroit, where orders have suddenly appeared for tools and shop equipment, particularly from the automobile plants.

NEW ENGLAND manufacturers report business as being fairly well maintained by orders for special production machinery. Little of importance is noted in New York, where conservatism rules buying. Philadelphia has some business from large industrials.

CANADA reports continued improvement during the month, sales and general activity being ahead of those of last year. Industrial activity in the Buffalo district promises better machinery business in the near future. Hand-to-mouth buying pertains in the South and basic conditions are sound.

The Industrial Review

Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

NEW ENGLAND

Machinery and machine tool business is fairly well maintained with possibly a slight falling off in some places, due principally to special causes. The business booked is single unit equipment and price is proving to be a factor in many instances. Small tools are being ordered in certain sections of New England. In the special machine lines delivery dates are the factors influencing business.

Machinery salesmen in general report that in order to secure the volume of business that has been obtained in the past two weeks it has been necessary to overcome an unusual amount of sales resistance. The Pratt & Whitney Aircraft Co., of Hartford, has business in hand to carry through until March, 1928; the Hartford Special Machinery Co. has orders to keep the plant at capacity for the rest of the year. The typewriter industry is busy.

Production machinery, turret lathes and tools have been in better demand. Hand tools are quiet. Manufacturers of equipment for the textile trade report a better volume of business.

SOUTHERN DISTRICT

Hand-to-mouth buying policy continues in the machinery and tool business. Little improvement is shown since the first of the month, though most of the distributors state that sales compare favorably with those for the corresponding period last season with the exception of garage and service station equipment, which is considerably less than last year.

Construction is assuming signs of spring activity and there is a larger demand for contractors' machinery and equipment. Road building machinery is fairly active, distributors reporting a number of good sales recently in all parts of the Southeast.

Railroads are starting a fairly large shop construction program in this district, and recently have announced several important projects in different Southeastern states, which will entail an investment of several million dollars, and are expected to result in a steady demand for heavier tools and equipment during the late spring and summer. At present, railroads are buying only on a fair basis, but their inquiry is normal for this period. Textile mills are still buying on a good basis and promise to be one of the leading buyers of equipment for the spring and summer season.

BUFFALO

While most industries in Buffalo are operating at a pace which is greater than has been the case in many months, the machine tool trade is quiet. One dealer characterized the present condition as a temporary lull. He seemed to think that the future was good. But no one is expecting any marked improvement until autumn.

The contractors' equipment market is active but still falls short by about 15 per cent of the business in this field last year at the same time. Moreover, there has been marked price cutting this season which has complicated the situation somewhat. One reason for the falling off lies in the fact that there is less general building this year than last and also in the fact that highway construction contractors are chiefly veterans in the game who are using equipment purchased in previous years.

The electrical equipment field shows a fair volume of small orders but the activity is not as great as that of last year at this time. However, those in all fields are still rather optimistic concerning the future.

NEW YORK

There is little of importance in the market news of this territory. Dealers in machinery and machine tools report that business on the whole is rather dull. Uncertainty in some lines of industry has held up a good volume of orders for equipment and the usual volume of small orders from machine shops and small users is below normal.

Heavy machinery used in the construction and in the fabrication of steel for building is one bright spot. Some good orders for this class of equipment have been recorded in the past two weeks. Hardware, electrical goods and metal novelty and specialty shops are busy and are buying tools for replacement here and there.

The railroads are inactive, only small orders having been received lately from the New York Central and from the Lehigh. The General Electric, Westinghouse and a few other large industrials placed orders for a few tools. The used tool market has fallen off recently, only the higher class machines being moved. Inquiries continue to call for single machines, but the total volume of such requests is not imposing, nor promising.

CANADA

Since the beginning of May there has been a marked improvement in the demand for machinery and machine tools in Canada. Business generally throughout the Dominion is about 10 per cent ahead of 1926. The favorable developments of the first quarter, and additional constructive factors recently noticeable, seem to insure the continuation of satisfactory business for the next two or three months.

Most metal working plants have sufficient orders on hand to keep them busy until midsummer. Manufacturers of farm implements are fully as busy as a year ago, while the demand for mining machinery and equipment is reported to be greatly in excess of this time last year. The electrical equipment industry is also well employed.

Production of iron and steel during April was maintained at a high level and there appears to be plenty of work on hand for the next two months. The Algoma Steel Corporation is reconstructing part of its rail mill at a cost of approximately $300,000, so as to be able to roll the 39-ft. rails now being demanded by the railways. The Canadian National Railways are preparing to spend $15,000,000 on new standard railway equipment, consisting of locomotives and cars.

The Canadian Car and Foundry Co., Amherst, Nova Scotia, is experiencing a boom in business. During April 128 carloads of billets were brought into the plant and rolled out as finished articles. The wheel foundry is engaged in turning out wheels for the Canadian National Railways.

Notwithstanding the great volume of construction in 1926, the projects now in progress and in contemplation are reported to be more numerous, so that it seems reasonably certain that building and engineering operations will again be on a large scale during the coming season.

PHILADELPHIA

Buying of machinery and machine tools in the Philadelphia market continued on a conservative basis during the last two weeks, with industrials, automobile manufacturers and railroads marking time to determine just what the future holds from an economic standpoint.

Manufacturers of refrigerating equipment have purchased some tools. A concern, whose relations with the trade is confidential, has made some substantial purchases, largely for experimental work. The Ford Motor Co. has entered the Philadelphia market for electric hoists, and one of the leading steel companies has made some purchases.

Inquiries have come from other industrial firms, some of which indicate orders may soon be closed, but generally speaking the trade does not see large quantity buying in the immediate future. Some buying was noted from public utilities, and the inquiries from that source were more hopeful of ultimate orders.

MILWAUKEE

The metal working equipment business shows little if any change. While orders are by no means plentiful, shop capacity is fairly well occupied and operations are sustained at a fair average. Deliveries, however, are proceeding more rapidly than new bookings are being made, but it is expected that a better balance is not far off. There is no lack of confidence in the situation, but merely a conservatism that is limiting activity in the acquisition of production equipment until a sustained need for more capacity is more or less assured.

Automobile shops are fair buyers, but this business is restricted, in the main, to replacement needs. Metal products shops generally are busy, but are refraining from making substantial enlargements of capacity despite the fact that the state of business at this time might justify the investment.

The demand for labor exceeds the supply in the metal and building trades, but there is a surplus of casual labor which is largely responsible for a declining payroll in the past four to six weeks.

CHICAGO

A slight though perceptible improvement in the trend of the machine tool market has been noted within the last week, as a result of which manufacturers' representatives and dealers believe that the slump has come to an end. Railroad buying has

increased to some extent, but is still considerably behind requirements as indicated by the lists already in the hands of the trade. The closing on a number of machine tools for railroad shop equipment, inquiries for which have been pending for several weeks, is expected shortly. Among the roads in the market for tools, the Santa Fé and Union Pacific are factors, with the St. Paul as a prospective buyer in the near future.

The International Harvester Co. is doing some buying, and the Illinois Steel Co. is closing on a number of items contained in its supplementary list. Manufacturers of hack saws and bandsaws report business for this year, thus far, as considerably in excess of that for the corresponding period of 1926. In the line of grinding machines and abrasives, manufacturers' representatives state that, with the exception of a slight lull experienced a few weeks ago, trade continues on a most satisfactory basis. Small tools of all types are in good demand.

General manufacturing in the Mid-West is showing increased production, a fact that indicates a better demand from this source may be soon looked for. The consensus of opinion in the machinery industry as to the outlook for continued improvement in market conditions is optimistic, the month of June being expected to show a considerable increase over May in the matter of sales.

CLEVELAND

A spotty condition continues to prevail in the local machinery and machine tool market. A few concerns report a slightly improved condition, but the majority state that hand-to-mouth buying still predominates. Orders closed were for the usual one and two pieces from scattered sources. Sales for May are running 10 to 20 per cent below April. One of the many reasons for the present ebb of the machine tool business, according to a local manufacturer, is the fact that some concerns have reached the limit of their ability to increase production.

Expectations of sales on quotations submitted to prospective buyers and the increase in new inquiries is having a tendency to preserve optimism. The Hoover Sweeper Co., of Canton, is reported to have issued a list of tools. The U. S. Aluminum Co., is buying some tools for its Cleveland plant. The Cleveland Board of Education is buying twenty items for the Thomas Edison trade school. The Ohio Brass Co. is also listed as a purchaser.

INDIANAPOLIS

While the volume of sales of machinery and equipment in this territory is fairly satisfactory, there are several soft spots in the demand, and until these are eradicated the situation will not assume normal proportions. Sales of mining equipment are nil, due to strike conditions. The farm implement factories also are curtailing their purchases.

A good demand continues to come from road builders and judging from the volume of road improvement already contracted for, both by the state and the various counties, this demand will remain good for the next three months. Many of the contractors who have been successful in securing jobs, are purchasing much additional equipment purely from precautionary viewpoint in order to insure that they will complete their jobs within the time limits fixed when the contracts are awarded.

Demand from the automotive industry is good. This is particularly true in sales of special woodworking machinery for the body factories, all of which have heavy order files and are operating at capacity. A good demand is reported for special machinery to be used in lumber manufacturing plants.

Garage equipment is active, with prospects of a better year in this line than last. A good demand for special machinery is being received from the furniture factories, in spite of the fact that many factories report business slower than last year.

Railroad buying is being held to a minimum and the spring and summer repair programs are just getting under way. Fabricating plants are rather poor customers also, but in the sheet metal mills a fair demand is being recorded for stamping machines, riveting machines and drills.

CINCINNATI

The majority of machine tool manufacturers in the Cincinnati district report that in the past two weeks the market has been dull and featureless. A few concerns reported that business was fairly good, with increased prospects for sales.

Some selling agents reported that in the past week they received a slightly-increased number of orders. The local demand for tools is growing better.

The greater part of the present business consisted of orders for single tools, coming from machinists and industrial users. The orders booked came from all sections of the country. A few single orders came from railroads and some came from automobile makers and manufacturers of accessories. Orders were expected from the Santa Fe, from its current list, but these did not materialize.

A good volume of inquiries came in during the week, and these are regarded as a justification for a greater business expectancy. It is stated that concerns that are badly in need of tools are still postponing indefinitely the placing of orders. The selling problem is not to find users who need tools, but to find a means of overcoming this caution.

DETROIT

There is a greater feeling of optimism in Detroit at this time than there has been in many weeks, as far as the machinery and machine tool business is concerned. There has been a scarcity of orders, with no prospect of an early improvement. This week, for no apparent reason, there is a noticeable change.

The motor industry has outwardly changed but little, but there is an undertone of confidence that has been missing for some time. The Ford Motor Co. is going forward with its plans for a new car. No large orders are being placed at this time, but there is a gradual adjustment of the enormous facilities. All the changes made here will be followed eventually by the Ford branches. Dealers with Canadian branches will probably find it to their advantage to look into this.

A number of orders have been placed here for small replacement machines. Thus far there are few orders for machinery for increasing production. A good many inquiries are coming in.

Thus far the deal by which the Graham Brothers acquired the Paige plant and the Wayne Body plant has not resulted in the placing of any orders for equipment. Briggs is still silent about plans for equipping a plant to replace the one lost in the recent fire.

Chicago Section of A.S.M.E. Elects

At the final seasonal meeting of the Chicago section of the American Society of Mechanical Engineers, held on May 11, Thomas Wilson, Western editor of *Power*, was elected chairman for the ensuing year. The other members elected to the executive committee were H. V. Coes, vice-chairman; Fred B. Orr, secretary-treasurer; Hugo Diemer, R. H. Bacon, J. I. Banash, C. B. Cole, and H. S. Dickerson, directors.

Personals

E. A. THUMLERT has resigned from the R. H. Beaumont Co., and the Beaumont Manufacturing Co., of Philadelphia.

W. H. NEVILLE, of Birmingham, Ala., has been appointed representative in Alabama for the Roller-Smith Co., of New York.

S. E. CONYBEARE, advertising manager of the Armstrong Cork Co., of Lancaster, Pa., has been elected a member of the board of directors of the Audit Bureau of Circulations.

H. A. COUSE, a member of the law department of the General Electric Co., has been appointed general counsel of the incandescent lamp department, with offices at 120 Broadway, New York.

WILLIAM A. ROCKENFIELD, for the past twelve years general manager of the Baldwin Chain and Manufacturing Co., of Worcester, Mass., has resigned. He has not made known his plans for the future.

W. H. MCINTYRE, general manager and vice-president of the Ottawa Car Manufacturing Co., Ottawa, Canada, has been appointed a director of the Industrial Accident Prevention Association of Canada.

ROBERT T. KENT has been appointed general manager of the Bridgeport Brass Co., of Bridgeport, Conn. He was formerly superintendent of prison industries in New York State.

F. H. BABCOCK, of the central station department, of the General Electric Co., has been designated as assistant to Charles W. Appleton, who was recently elected vice-president in charge of general relations with public utilities.

BASIL JOHNSON, managing director of Rolls-Royce, Ltd., of Derby, Eng., has been visiting the plant of Rolls-Royce of America, Inc., in Springfield, Mass. He was honor guest at a luncheon in the Colony Club, Springfield, on May 12.

A. A. EAKINS has been appointed district representative in the Boston territory for the Standard Electric Tool Co., of Cincinnati. He has established offices at 12 Pearl St., in Boston.

WILLIAM E. BULLOCK has been appointed secretary of the American Institute of Weights and Measures. He succeeds the late C. C. Stutz. Mr. Bullock has been associated with the A.S.M.E., and with Franklin Institute.

E. A. MULLER, of the King Machine Tool Co., and J. T. FAIG, of Ohio Mechanic's Institute, were tendered a testimonial dinner on May 21 by the Cincinnati Section of the American Society of Mechanical Engineers.

J. HERBERT DOUGHERTY has resigned as manager of the Montreal branch of the General Supply Co., of Canada, Ltd., in order to accept a position in the sales department of the Canada Iron Foundries, Ltd., Montreal.

F. C. A. H. LANTSBERRY, managing director of William Jessop & Sons, Ltd., Sheffield, England, is now visiting in the United States. While here he will have headquarters at the company's main office at 91 John St., New York.

C. L. CAMERON, formerly sales manager for Gould & Eberhardt, of Newark, N. J., has taken over the sales agency in the New Jersey territory for the Monarch Machine Tool Co., of Sidney, Ohio.

GEORGE H. THOMSON, for the past fourteen years associated with the Swartwout Co., of Cleveland, has resigned and has become president of the Stanton-Thomson Corporation of 75 West St., New York.

E. R. WYLER, who has been connected with the Cleveland sales office of the Independent Pneumatic Tool Co., of Chicago, has been transferred to the sales department at the company's general office in Chicago. Mr. Wyler will make his headquarters in St. Paul.

L. J. PURDY, former production manager of the Oakland Motor Car Co., has been appointed factory manager of the H. H. Franklin Manufacturing Co., makers of the Franklin automobile. Mr. Purdy will have general charge of manufacturing, purchasing and quality control departments.

M. BROCKLEBANK, of the Montreal Trust Co., has been appointed comptroller for the Dominion Iron and Steel Co., succeeding M. A. Doak, who has resigned. Mr. Doak continues as comptroller of the British Empire Steel Corporation and other constituent companies.

CHARLES E. DURYEA, pioneer automobile inventor, was the guest of honor of the Publicity Club of Springfield, Mass., on May 10, when he was given a medal for distinguished service to the world. The presentation was made at a dinner in the Hotel Kimball, when Mr. Duryea related the circumstances of the building of the first Duryea car in 1892, in the machine shop of the John W. Russell & Sons Co., in Springfield.

FRANK J. WESCHLER has retired as president and general manager of the Indian Motorcycle Co. of Springfield, Mass., to become president, treasurer and general manager of the Baldwin Chain and Manufacturing Co. of Worcester, Mass. Claude Douthit, of Brown & Marshall, investment brokers of New York, succeeds Mr. Weschler as president of the Indian company, and Louis E. Bauer, a director in the company, becomes general manager. Mr. Bauer is vice-president of Bauer Bros. Co. of Springfield, O., and was recently connected with the Servel Corporation of New York.

Obituaries

IRA H. WOOLSON, for seventeen years consulting engineer to the committee on construction of buildings for the National Fire Underwriters, died in Chicago on May 8. He was 71 years old.

BENJAMIN ATHERTON HAWLEY, vice-president of the American Hardware Corporation, and general manager of the Russell & Irwin Co., of New Britain, Conn., died on May 11 at his home in that city. Mr. Hawley was 59 years old.

Business Items

The Link-Belt Co., of Chicago, has started the construction of a new branch plant in Toronto, Canada.

The board of directors of the Colonial Steel Co., of Pittsburgh, has called for redemption, on June 1, all the outstanding preferred stock of the company.

The Reading Chain and Block Co., of Reading, Pa., announces the removal of its New York office from West St. to Room 1193 Park Bldg., on Park Place. R. E. Nelles is in charge.

The Atkinson Equipment Co., of Atlanta, Ga., has been appointed sales representative in Georgia for the Roller-Smith Co., manufacturer of electrical instruments, of New York.

The McCarthy & Robinson Co., of 307 Reford Bldg., Toronto, Canada, has been appointed Canadian representative for the Electric Controller & Manufacturing Co., of Cleveland.

The Monarch Machine Tool Co., of Sidney, Ohio, will open a metropolitan sales office in the Graybar Bldg., Lexington Ave., New York. This office will be ready about the middle of June.

The Petroleum Electric Co., Tulsa, Okla., has been appointed sales agent in Oklahoma and the Panhandle district of Texas for the Electric Controller and Manufacturing Co., of Cleveland.

The A. M. Stoehr Machinery Co. has removed its warehouse from 560 W. Adams St. to 106 S. Jefferson St., Chicago, and has opened an office in the Mid-City Bank Bldg., Madison and Halsted Sts.

The Triplex Machine Tool Co., of 50 Church St., New York, has been appointed sales representative in New England, New York, New Jersey and eastern Pennsylvania for the General Manufacturing Co., of Detroit, manufacturer of power presses.

Articles of incorporation have been issued to the Chicago Tool and Engineering Co., 8389 S. Chicago Ave., to trade in machinery. The incorporators are: C. A. Palmgren, Clarence A. Palmgren and Henry R. Bettis.

The Eaton Electric Furnace Co., of Taunton, Mass., has changed its name to the Sentry Co., and the product in the future will be known as the "Sentry" electric heat-treating furnace. There has been no change in the personnel or in the management of the company.

The G. A. Schacht Motor Truck Co., of Cincinnati, announces that effective May 14, the corporate name of the company will be changed to the LeBlond-Schacht Truck Co. There will be no change in the officers or in the management of the firm.

The Browning-Ferris Machinery Co., of Dallas, Tex., machine tool and mill supply distributor in the Southwestern territory, announces a recent increase in the company's capital stock to take care of expanding the scope of the business during the present year.

The Staytite Co., of Houston, Tex., was recently organized for the distribution of a general line of machine tools in the Southwestern territory, according to an announcement by George C. Schmidt, 100 Roberts St., Houston, one of the officials of the company.

The Austin Co., engineers and builders, whose headquarters are located in Cleveland, has opened a branch office in the Dixie Terminal Bldg., Cincinnati. H. L. Cornelison, until recently manager of the Miami office, has been placed in charge.

The Brown Hoisting Machinery Co., manufacturer and distributor of several types of cranes and shovels, machinery and conveying equipment, has opened a St. Louis district office at 471 Paul Brown Bldg., Charles C. Dancer, formerly attached to the Chicago office, is in charge.

Samuel C. Rogers & Co., of Buffalo, N. Y., announce the removal of their plant to the recently constructed building at 191 Dutton Ave., in that city. The new factory is equipped with modern machinery and special apparatus for the manufacture of grinders and sharpeners.

The Power Specialty Co., of New York, distributor of power equipment, announces the opening of a new branch office in the Bona Allen Bldg., Atlanta, to handle the company's trade in the Georgia, Alabama, South Carolina, Florida and Tennessee territory. J. W. Lea is in charge of the branch as district manager.

The Southern Railway System, according to an announcement by G. L. Sitton, chief engineer, has awarded a contract to the Brooks-Callaway Co., of Atlanta, for the construction this summer of new locomotive and machine shops at Charlotte, N. C., cost of which will be approximately $1,000,000.

At the annual meeting of the Metals Coating Co. of America, at the main offices in Philadelphia, Richard L. Binder was re-elected president. E. Heinzerling, a director of the Siemens-Schukert Co., of Hamburg, Germany, was elected a director of the company. All other officers and directors were re-elected.

A federal charter has been granted by the Canadian government to Foundry Engineers, Ltd., which company will carry on the business of mechanical engineers and manufacturers of engines, agricultural implements and other machinery, toolmakers, brass founders, metal workers, machinists, etc. Headquarters will be in Calgary, Alberta.

Dwight W. Morrow, of J. P. Morgan and Co., and Victor M. Cutter, president of the United Fruit Co., were elected directors of the International General Electric Co., at a meeting of the board on April 30. Gerard Swope, president of the General Electric Co., was elected chairman of the board, succeeding the late Anson W. Burchard; Clark H. Minor was re-elected president.

The Box Crane and Hoist Corporation, of Philadelphia, announces the appointment of the following sales representatives: Gray Foundry, Inc., Poultney, Vt.; F. R. Quigley, Baltimore; Maintenance Engineering Co., Houston, Texas; Spencer & Morris, Los Angeles, Calif.; R. E. Condit, Dayton, Ohio; W. J. Laufenburg, Kansas City; W. F. Moody & Co., Little Rock, Ark.; St. Louis Structural Steel Co., St. Louis; J. F. Bruce, Cleveland.

The ownership and control of a prominent Canadian industrial company which has rested in the United States for the last 30 years now rests in Canada, through the purchase by Greenshields & Co. and Flood, Barnes & Co., Ltd., of Canadian Bronze, Ltd., and subsidiaries. Canadian Bronze, Ltd., through its Montreal plant and its subsidiaries' plants at St. Thomas, Ontario, Winnipeg, and Calgary, Alberta, manufactures and supplies the Canadian railroads with bronze bearings and bushings for freight cars, passenger cars and locomotives. The company was formed over 30 years ago by interests connected with the Magnus Bronze Company, of the United States at that time. Until now it has been owned and directed by Stewart H. Jones, of New York, and his immediate associates.

Forthcoming Meetings

Associated Machine Tool Dealers. Annual spring meeting at Granville, Ohio, May 25, 26 and 27. Tyler W. Carlisle, secretary, the Strong, Carlisle & Hammond Co., 1392 West Third St., Cleveland, Ohio.

National Foreign Trade Council. Fourteenth national foreign trade convention, Hotel Statler, Detroit, Mich., May 25, 26 and 27. O. K. Davis, secretary, India House, Hanover Square, New York.

Society of Industrial Engineers. Annual meeting, Hotel Stevens, Chicago, May 25, 26 and 27. George C. Dent, secretary, 608 S. Dearborn St., Chicago, Ill.

Society of Automotive Engineers. Summer meeting, French Lick Springs, Ind., May 25 to 28. C. E. Heywood, manager of meetings department, 29 W. 39th St., New York City.

American Foundrymen's Association. Annual convention, Edgewater Beach, Chicago, June 6 to 10. R. E. Kennedy, secretary, 909 W. California St., Urbana, Ill.

National Supply and Machinery Distributors' Association. Twenty-second annual convention with the **Southern Supply and Machinery Dealers' Association**, and the **American Supply and Machinery Manufacturers' Association**, on board the steamship *Noronic*. Boat leaves Detroit, Mich., June 13 and returns there June 17. George A. Fernley, secretary, 505 Arch St., Philadelphia, Pa.

Exposition of Engineering Developments. Under the auspices of the Association of Iron and Steel Electrical Engineers, in the Empire Bldg., Pittsburgh, June 13 to 18. John F. Kelly, general chairman, 705 Empire Bldg., Pittsburgh.

American Society for Testing Materials. Annual meeting at French Lick, Ind., June 20 to 24. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia.

American Railway Tool Foremen's Association. Fifteenth annual meeting, Hotel Sherman, Chicago, Aug. 31, Sept. 1 and 2. G. G. Macina, secretary, 11,402 Calumet Ave., Chicago.

Machine Tool Exhibit. Seventh annual machine tool exhibition under the auspices of the New Haven Section of the American Society of Mechanical Engineers, the Department of Mechanical Engineering of Sheffield Scientific School, Yale University, and the Chamber of Commerce of New Haven: At the Mason Laboratory, Yale University, Sept. 6 to 9. Harry R. Westcott, chairman of the exhibit committee, 400 Temple St., New Haven, Conn.

American Society for Steel Treating. Ninth annual convention and national steel exposition, Detroit, week of Sept. 19. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland.

Machine Tool Builders' Exposition. First annual machine tool exposition, conducted by the National Machine Tool Builders' Association, at the West Annex of the Public Auditorium, Cleveland, Ohio, Sept. 19 to 24. J. Wallace Carrel, vice-president and general manager, the Lodge & Shipley Machine Tool Co., Cincinnati, chairman of the exposition committee. Roberts Everett, manager of the exposition, 225 West 34th St., New York. Ernest F. DuBrul, general manager of the association, 826 Provident Bank Bldg., Cincinnati, Ohio.

The Weekly Price Guide

Rise and Fall of the Market

THE principal price advance of the last two weeks was that affecting steel sheets, both black and galvanized, at mills. Linseed oil is also higher in the West and coke increases in firmness. Better demand is noted in railway material, steel plates, strips, sheets, and bars, than a few weeks back. Price declines affect mainly, blue-annealed sheets, solder, zinc sheets, highest grade babbitt and scrap lead and zinc. The pig-iron market appears weaker, while automotive steel demand is comparatively quiet. The foregoing developments have succeeded in causing no weakness in quotations on the principal hot-rolled steel materials. Bars are $1.90 and shapes and plates, $1.80@$1.90 per 100 lb., base, Pittsburgh mill, which prices have prevailed for the last several weeks.

(*All prices as of May 20*)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$22.19
Northern Basic	20.89
Southern Ohio No. 2	21.19
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	26.37
BIRMINGHAM	
No. 2 Foundry	18.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	22.76
Virginia No. 2	27.17
Basic	21.76
CHICAGO	
No. 2 Foundry local	21.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	23.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	20.26
Basic	19.76
Bessemer	21.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.00@4.50
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	4.75@5.25

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.20@2.25	3.50	3.25	3.89
No. 12	2.25@2.30	3.55	3.30	3.94
No. 14	2.30@2.35	3.60	3.35	3.99
No. 16	2.40@2.45	3.70	3.45	4.09
Black				
Nos. 18 to 20	2.55@2.65	3.75	3.25	4.00
No. 22	2.70@2.80	3.90	3.40	4.15
No. 24	2.75@3.00	3.95	3.45	4.20
No. 26	2.85@2.95	4.05	3.55	4.30
No. 28	3.00@3.10	4.20	4.70	4.45
Galvanized				
No. 10	3.05@3.15	4.10	3.95	4.25
Nos. 12 to 14	3.15@3.25	4.20	4.05	4.35
No. 16	3.25@3.35	4.30	4.15	4.45
No. 18	3.40@3.50	4.45	4.30	4.60
No. 20	3.55@3.65	4.60	4.45	4.75
No. 22	3.60@3.70	4.65	4.50	4.80
No. 24	3.75@3.85	4.80	4.65	4.95
No. 26	3.95@4.05	5.05	4.90	5.20
No. 28	4.20@4.30	5.30	5.15	5.45

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft. or 100 lb.:

Thickness — Decimal	B.w.g. and Fractions	Outside Diameter in Inches — ¼	⅜	½	⅝	1	1¼	1½
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	....	4.65
Spring steel, heavier	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.30	5.00
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.10	3.10
Soft steel bars (base)	3.24	3.00	3.00
Soft steel bar shapes (base)	3.24	3.00	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.20	3.10
Bar iron (2.75 at mill)	3.24	3.21	3.00
Drill rod (from list)	60%	55%	50%

Electric welding wire, New York, 3/32, 8.35c.; ⅛, 7.85c.; 5/32 to ½, 7.35c. per lb. *Flat, 1/16@¼-in. thick.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic, up to carlots, New York			14.25
Tin, pigs, 5-ton lots, New York			67.75
Lead, pigs, up to carlots, E. St. Louis	6.30	New York	7.25
Zinc, slabs, up to carlots, E. St. Louis	6.00	New York	7.00

	New York	Cleveland	Chicago
Antimony, slabs, ton spot	16.00	17.50	15.00
Copper sheets, base	21.75	21.75	21.75
Copper wire, base	18.62½	18.37½	18.50
Copper bars, base	21.37½	21.37½	21.37½
Copper tubing, base	23.75	23.25	23.75
Brass sheets, high, base	18.12½	18.12½	18.12½
Brass tubing, high, base	23.00	23.00	23.00
Brass rods, high, base	15.87½	15.87½	15.87½
Brass wire, high, base	18.62½	18.37½	18.62½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	26.00	26@27	26.02
Zinc sheets (casks)	11.25	11.30	11.36
Solder (½ and ½), (case lots)	41.00	42.50	38½@42½

Babbitt metal, delivered, New York, cents per lb.:

Genuine, highest grade	85.00
Commercial genuine, intermediate grade	61.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	13.00

Nickel, f.o.b. refinery, cents per lb.:

Ingots	35.00	Electrolytic	39.00
Shot			36.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	35.00
Blocks	32.00	Cold drawn rods (base)	43.00
Cold rolled sheets (base)	50.00	Hot rolled sheets (base)	42.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	11.50 @11.75	10.75	10.25@10.75
Copper, heavy, and wire	10.75 @11.25	11.00	9.50@10.00
Copper, light, and bottoms	9.25 @ 9.75	9.50	8.50@ 9.00
Heavy lead	5.25 @ 5.50	5.25	5.50@ 6.00
Tea lead	4.00 @ 4.75	3.25	4.25@ 4.75
Brass, heavy, yellow	7.25 @ 7.50	7.00	6.50@ 7.00
Brass, heavy, red	9.00 @ 9.25	9.50	8.75@ 9.25
Brass, light	5.50 @ 5.75	6.00	5.75@ 6.25
No. 1 yellow rod turnings	7.50 @ 7.75	7.50	6.75@ 7.25
Zinc	4.00 @ 4.25	3.00	3.00@ 3.50

TIN PLATES—Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.95	$11.50
"A" Grade:				
IC,	14x20	9.70	9.90	9.50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.10@0.13½	$0.16	$0.15@0.20
Cotton waste, colored, per lb.	.09@ .13	.12	.12@.17
Wiping cloths, washed white, per lb	.15½	36.00 per M	.15
Sal soda, per lb	.02½	.02	.02½
Roll sulphur, per lb	.02¾	.03½	.04
Linseed oil, raw, per 7½-lb. gal., 5 bbl. lots	.87½	.99	.90
Lard cutting oil, 25% lard, in 5 gal. cans, per gal.	.55	.50	.50
Machine oil, medium-bodied (55 gal. metal bbl.), per gal.	.33	.35	.29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.04
Brass rods	per lb	.1587½	.1587½	.1662½
Solder (½ and ½)	per lb.	.41	.4175	.385
Cotton waste, white	per lb.	.10@13½	.10@.13½	.13@.17½
Emery disks, cloth, No. 1, 6 in. dia.	per 100	3.10	3.10	3.55
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.33	.33	.35
Belting, leather, medium	off list	40–5%	40–5%	40–5%
Machine bolts, up to 1x30 in., full kegs	off list	50%*	50%*	40%

*New list April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
*Flint paper	$5.13	$4.95	$5.13
*Emery paper	10.71	9.15	10.71
*Emery cloth	27.84	27.85	27.84
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.29	1.27	1.32
Cloth	3.10	3.05	3.05
Fire clay, per 100 lb. bag		.75	.75
Coke, prompt furnace, per net ton		Connellsville,	2.75@3.00
Coke, prompt foundry, per net ton		Connellsville,	4.00@4.50
White lead, dry or in oil,	100 lb. kegs		New York, 15.25
Red lead, dry,	100 lb. kegs		New York, 15.25
Red lead, in oil,	100 lb. kegs		New York, 16.75

*4½ reams and under.

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

	Broken Kegs or Cases	Full Kegs or Cases
Machine bolts, square heads and nuts:		
Up to ¾ x 6-in	50%	50–10%
Larger up to 1 x 30-in	45%	50%
1⅛ and 1¼ in. dia	30%	35%
Carriage bolts:		
Up to ½ x 6-in	50–10%	
Larger sizes	50%	
Coach and lag screws:		
Up to ½ x 6-in	50–10%	
Larger sizes	50%	
Tap bolts, hexagonal heads	45%	
Nuts:		
Hot pressed, square and hexagonal, blank or tapped	45%	50–10%
Cold punched, square and hexagonal, blank or tapped	45%	50–10%
Semi-finished, hexagonal, tapped, in packages	40%	
Case hardened, hexagonal, tapped, in packages	30%	
Washers: Deduct from list, per 100 lb.	$1.50	$3.50
Rivets, button and cone head:		
Small, including ⅞-in. dia		50–10%
Large (base) per 100 lb.	$6.50	$5.00

EXTRA per 100 lb. on rivets, for ¼-in. dia., 35c.; ⅜-in., 15c.; 1-in., 5c.; lengths 1-in. and shorter, 25c.; longer than 1-in. up to and including 1 ¼-in., 15c. longer than 5-in., 25c.; standard countersunk head, 25c.

Machine Requirements and Industrial Construction

Equipment Wanted

Conn., Thompsonville—Bigelow Hartford Carpet Co.—planer type milling machine.

D. C., Washington—Bureau of Supplies & Accounts, Navy Dept.—motor driven grinders and shapers for Navy Yard, Boston, Mass.

Md., Baltimore—The Anchor Post Fence Co., 9 East 38th St., New York, N. Y.—5 ton electric crane, 50 ft. span for proposed 1 story, 200 x 500 ft. factory here.

Md., Cumberland—N. & G. Taylor Co. Inc.—one 36 or 42 in. double shear for tin mill and one motor driven vertical shear to cut sheet bar cold, knife about 20 to 24 in. long.

Mass., Boston—H. E. Cline, 43 Tremont St.—miscellaneous tools and equipment for proposed repair and service garage at Dorchester, Mass. Estimated cost $75,000.

Mass., Brookline (Boston P. O.)—H. M. Rambach, 18 Tremont St., Boston—machinery and equipment for proposed machine shop, here.

Mass., Malden (Boston P. O.)—Malden Grinding & Welding Co., 151 Exchange St.—arc welder.

Mich., Detroit—Wolverine Stamping Co., 6565 Russell St.—medium size duty power press.

O., Cleveland—Bd. of Education, 431 Rockwell Ave., will receive bids until May 31 for two wood turning lathes, two 14 in. x 6 ft. Monarch lathes, one bench lathe, two sensitive drill presses, one arbor press, one 20 in. vertical drilling machine, one 2 wheel electric grinder, one 14 in. grinder, one 30 in. band saw, one 24 in. single cylinder surfacer, one Carter shaper, one 15 in. disc sander and three anvils and bases for Thomas E. Edison Trade School.

Pa., Coraopolis—The Austin Co., 16112 Euclid Ave., P. J. Brennan, Purch. Agt.—7 or 8 overhead electric cranes, etc. for proposed new plant of Russell, Birdsall & Ward, Port Chester, N. Y., here.

Pa., Pittsburgh—Dravo Contracting Co., Neville Island—alligator shear.

Pa., Reading—William F. Remppis Co. Inc.—3/16 x 96 in. drop brake and 3/16 x 96 in. power shear.

Ont., Brantford—Canada Valve & Hydrant Co. Ltd.—machinery and equipment for proposed new plant.

Ont., Pembroke—Steel Equipment Co. of Canada Ltd., D. P. Cuikshanks, Mgr.,—general equipment for the manufacture of iron work.

Ont., Toronto—City, T. Foster, Mayor, City Hall—will receive bids until May 31 for one 16 in. x 10 ft. heavy duty engine lathe, one heavy pony planer, etc.

Que., Montreal—Cleophas St. Aubin, 78 St. Henry St.—complete equipment for proposed garage, repair shop and service station.

Que., Montreal—P. Guidazio, 580 Durocher St.—complete equipment for proposed garage and service station.

Australia, Melbourne—Victorian Government Railways—will receive bids until July 17 for a 30 ton overhead electric traveling crane.

Opportunities for Future Business

Calif., Los Angeles—Woolwine Metal Products Co., 2421 East 8th St., is having plans prepared for the construction of a group of 1 story factory buildings on 52nd St. The Austin Co. of California, 777 East Washington St., Engr.

Calif., San Francisco—S. Rasori, 270 Tehama St., will build a machine shop at Third St. and Jerrold Ave. Estimated cost $12,000.

Calif., Santa Monica—Pratt Furniture Co., Los Angeles, is having plans prepared for the construction of a 3 story, 70 x 108 ft. factory here. Estimated cost $40,000. J. M. Cooper, 301 Rives-Strong Bldg., Los Angeles, Archt.

Conn., Bridgeport—Bridgeport Metal Goods Co., Cherry St., awarded contract for the construction of a 2 story, 60 x 240 ft. plant. Estimated cost $100,000. Noted May 12.

Ill., Chicago—Holton Seelye Co., 140 South Dearborn St., plans the construction of a 2 story, 127 x 135 ft. factory at 1807-1827 North Kostner Ave. Estimated cost $19,500. L. Russell, 140 South Dearborn St., Archt. Auto Ventilator Fan & Blower Co., 730 West Monroe St., manufacturers of ventilation apparatus, lessee.

Ind., Elkhart—Adams & Westlake Co., 319 West Ontario St., Chicago, Ill., brass founders, finishers, etc., awarded contract for the construction of a 1 and 2 story, 361 x 495 ft. factory at Mishawaka, Ward, Myrtle and Randolph Sts. here. Estimated cost $500,000. Noted Apr. 7.

Ind., Ft. Wayne—Fries Tool & Machine Co., awarded contract for the construction of machine shop. Estimated cost $40,000. Noted Apr. 28.

Ind., Indianapolis—Meridian Service Co., 2451 North Meridian St., awarded contract for the construction of a machine shop and garage. Estimated cost $42,000. Noted Mar. 24.

Ia., Marshalltown—Cooper Mfg. Co., 411 South Fourth St., manufacturers of auto heaters, awarded contract for the construction of a 1 and 2 story, 38 x 150 ft. factory on South First St. Estimated cost $40,000.

Ia., Waterloo—John Deere Tractor Co., will soon receive bids for the construction of a 1 story, 120 x 300 ft. addition to plant at Miles and Commercial Sts. Private plans.

Kan., Emporia—Atchison, Topeka & Santa Fe Ry., 80 East Jackson Blvd., Chicago, Ill., will receive bids until May 31, for the construction of a planing mill and roundhouse, etc., here. H. W. Wagner, Topeka, Kan., Ch. Engr. (Eastern Line).

Mass., Lawrence—Emerson Mfg. Co., Market St., manufacturers of pulp and paper mill machinery, awarded contract for the construction of a 1 story, 50 x 220 ft. factory. Estimated cost $45,000. Noted May 5.

Mass., West Newton (Boston P.O.)—G. W. Hoar Co., 18 Bedford St., Waltham, will build a 2 story assembly and finishing plant at 241 Rumford Ave. here. Estimated cost $40,000. L. G. Bracket, 88 Tremont St., Boston, Archt.

Mass., Worcester—Thompson Wire Co., G. S. Pease Engr., 115 Stafford St., awarded contract for the construction of four manufacturing buildings. Estimated cost to exceed $40,000. Private plans.

Mich., Detroit—Bohn Aluminum & Bronze Corp., 2512 East Grand Blvd., had plans prepared for the construction of a 1 story aluminum castings factory. C. W. Brandt, 1116 Francis Palms Bldg., Archt.

Mo., St. Louis—Westinghouse Electric & Mfg. Co., 3860 Bingham Ave., is having preliminary plans prepared for the construction of two buildings for the manufacture of street lighting poles. Estimated cost $500,000. Private plans.

N. J., East Orange—A. P. Smith Mfg. Co., 275 North Arlington Ave., will soon award contract for the construction of a 50 x 70 ft. addition to pattern shop. Estimated cost $60,000. Private plans.

N. J., Jersey City—J. A. Holgger, Inc., 351 Palisades Ave., manufacturers of plumbing fixtures, is having preliminary plans prepared for the construction of a plant. Estimated cost $40,000.

N. J., Newark—Griffith Piano Co., 605 Broad St., awarded contract for the construction of a 15 story factory. Estimated cost $1,000,000. Noted Jan. 27.

N. J., Newark—Newark Gear Cutting Machine Co., 65 Prospect St., awarded contract for the construction of a 2 story, 48 x 93 ft. addition to pattern shop. Estimated cost $50,000. Noted Apr. 21.

N. Y., Rochester—Metal Arts Co., J. Jack, Pres., 77 South Ave., will soon award contract for the construction of a 1 story factory on Portland Ave. Estimated cost $40,000. B. Frank Kelly, 302 Terminal Bldg., Archt.

O., Cincinnati—Cincinnati St. Railway Co., Dixie Terminal Bldg., awarded contract for the construction of a 1 story car shop on Mitchell Ave. Estimated cost $600,000. Noted May 5.

O., Cleveland—Hickok Electric Instrument Co., R. O. Hickok, Pres., 10514 Dupont Ave., will soon award contract for the construction of a 2 story, 30 x 42 ft. addition to factory. Estimated cost $40,000. H. M. Morse, Finance Bldg., Archt. and Engr.

O., Columbus—J. P. Gordon Co., 270 North Fourth St., manufacturers of automobile accessories, is having sketches made for the construction of a 5 story, 180 x 250 ft. factory on Spring St. Estimated cost $400,000.

O., Euclid—The Euclid Crane & Hoist Co., W. White, Secy., Chardon Rd., plans the construction of a 1 story, 40 x 170 ft. addition to factory. Estimated cost $40,000. Private plans.

Pa., Philadelphia—Crescent Box Co., D. and Erie Sts., will soon award contract for the construction of a 2 story, 80 x 300 ft. factory. Ballinger Co., 12th and Chestnut Sts., Archt. Noted May 5.

Pa., Philadelphia—D. J. Keating, 2042 Rittenhouse St., manufacturers of plumbing fixtures, will soon award contract for the construction of a 2 story, 68 x 100 ft. shop at 613-623 South 24th St. Ballinger Co., 12th and Chestnut Sts., Archt.

Pa., Philadelphia—O. P. Schuman, 2226 North 6th St., awarded contract for the construction of a 1 story, 36 x 60 ft. machine shop at American and Cayuga Sts.

Pa., Pittsburgh—R. D. Nuttall Co., Harrison Ave., manufacturers of bolts, is having plans prepared for the construction of a 1 and 3 story plant at 54th St. Estimated cost $200,000. B. H. Prack, Martin Bldg., Archt.

Wis., Baraboo—M. Feinberg, plans the construction of a 1 story, 60 x 90 ft. service station. Estimated cost $40,000. Architect not selected.

Wis., Burlington—Hansen Oil Co., will build a service station. Estimated cost $40,000. Foeller & Schoeber, Nicolett Bldg., Green Bay, Archts.

B. C., Nanaimo—Nanaimo Lumber Co., is having plans prepared for the construction of a saw mill. Estimated cost $75,000. Private plans.

Ont., Hamilton—Smiths Garage & Transport Co., Simcoe St. S., Oshawa, plans the construction of a 1 story, 119 x 400 ft. garage here. Estimated cost $100,000.

Ont., Toronto—Link-Belt Ltd., 910 South Michigan Ave., Chicago, Ill., awarded contract for the construction of a 2 story, 80 x 160 ft. factory at Eastern Ave. and Leslie St. here. Noted Feb. 10.

Que., Gros Pin—Shawinigan Water & Power Co., will soon receive bids for the construction of a smelter mill.

Japan, Kawasaki—Tokyo Electric Co., subsidiary of the Lamp Works Division of the General Electric Co., awarded contract for the construction of first unit to lamp factory 3 story, 180 x 400 ft. to H. K. Ferguson Co., 4900 Euclid Ave., Cleveland, O.